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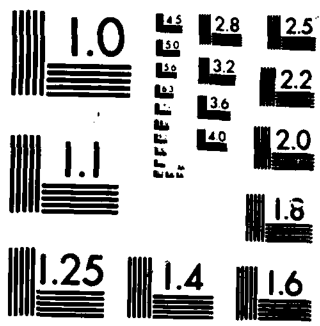

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Meroplankton Monitoring Data from a Fixed Platform in the Chesapeake Bay Mouth, 1982 - 1983

AD-A165 062

Ray S. Birdsong, David W. Byrd, James F. Matta, and Bert W. Parolari, Jr.

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Report describes a highly successful sampling technique that has great potential for long-term data acquisition (monitoring implications at reduced costs and inconvenience).

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Introduction

Long-term monitoring studies of non-commercial marine organisms are rare, especially studies of zooplankton populations. Where such data bases exist they are frequently the source of unique and valuable information. The importance of long-term data bases is the continuity of data over time hence their maximum value is only realized after a number of iterations of the ecological cycle under study. This report constitutes a preliminary look at the first two years of data from what we hope will become a continuing study of meroplankters in the Chesapeake Bay mouth.

Among the objectives of this research were to compare the technique of monitoring zooplankton from a fixed platform, (the fishing pier on the South Island of the Chesapeake Bay Bridge-Tunnel) with towed collections. The fixed platform sampling approach was selected for testing because it is both less expensive and, not being weather dependent, more reliable than boat towed collections. These are both important considerations in the establishment of a long-term program.

At present the data from the companion towed stations are unavailable to us, consequently the level of success of this approach cannot be fully evaluated here. The data, however, constitute a unique data set in that they comprise the largest discrete depth meroplankton study conducted in the bay mouth region and consequently merit discussion in

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themselves.

An additional report comparing the 2 colection techniques will be forthcoming when all data are available.

Sampling Regime and Methodolgy

Sampling was conducted semimonthly from January 1982 through December 1983 from the end of the fishing pier which extends from the South Island of the Chesapeake Bay Bridge-Tunnel contiguous to the Thimble Shoal Channel.

Samples were taken at the following discrete depths:

(1) surface

(2) one meter below the surface

(3) one meter above the bottom

(4) bottom

Each series of samples comprised three or four serial replicates each of fifteen minutes duration at each depth. The volume of water filtered varied widely between sampling dates and depths and occasionally between replicates.

Two types of net frames were employed, both fitted with 353 micron mesh conical nets with 0.5 m diameter openings. Neuston and bottom samples were taken with the net fitted to a rectangular frame 21.5 cm x 55.5 cm yielding a mouth area of 1193.25 sq. cm. When fished at the surface as a neuston net, the rectangular frame was fitted with side floats which held the upper portion of the frame above the surface. When

fished in this mode, the effective fishing area of the mouth was approximately 895 sq. cm.

Below the surface and above the bottom samples were taken with the nets fitted to a 1/2 m mouth diameter circular bongo frame which yielded a mouth area of 1963.5 cm . Since this yielded two simultaneous replicates, the gear was fished for two fifteen minute sets at each depth during a series to produce two serial sets of two simultaneous replicates. All four replicates were treated the same.

All nets were equipped with torpedo type flow meters with "low flow" rotors (General Oceanics model #2030). Temperature and salinity were taken with an inductive salinometer at the surface and bottom at the start and end of each sampling-series (Tables 1 and 2). During the first five months of the study, surface and bottom current speed and direction were monitored with a Bendix model Q-9 current meter. Current measurements were discontinued in May of 1982.

Passive sampling inherently samples a smaller volume of water than towed samples of the same duration, consequently, in this study, sampling was conducted on or near the new and full moons when tidal currents were presumed to be at their maximum. For the first nine months of the study, January 1982 to September 1982, sampling was conducted on both the ebb and flood tides near the presumed time of maximum flow. This sampling protocol presented many difficulties, as outlined below, and was abandoned for a single series of samples

on each sampling date taken without regard to tidal stage. The original protocol presented the following problems:

(1) Current speed and sometimes direction near the surface were partially, but importantly dependent upon wind speed and direction and freshwater outflow of the bay drainage systems.

(2) Time of tide change and maximum ebb and flood were impossible to anticipate within the limits required by the protocol.

(3) Time of maximum velocity of near-surface and near-bottom waters were usually out of phase, sometimes by several hours. Direction of flow differed in surface and bottom waters during a portion of each tidal cycle and on occassion throughout an entire tide phase.

Samples were concentrated into one quart containers and preserved in the field in 10% formalin in seawater. During the sorting process in the laboratory, samples were split as required following the "CVS" method of Alden, et al (1982). Splits were accomplished with a Folsom plankton splitter and subsamples were randomly selected for sorting. All meroplankton in each subsample sorted were enumerated and identified to the lowest taxonomic level possible under the budgetary constraints of the project.

After sorting, subsamples were recombined and all samples were archived in the Department of Biological Sciences, Old Dominion University, Norfolk, Virginia.

Results and Discussion

The results presented here are preliminary and involve no statistical scrutiny. Variation between replicates is, however, obviously high.

Tables 3 and 4 show the frequency and density of meroplankters collected in 1982 and 1983. In these tables the frequency represents the number of replicates in which an organism appeared, e.g., if an organism appeared in a single sampling series in all three replicates at all four depths, it has been counted as twelve occurences in the yearly total. Also, the density represents the cumulative density at all depths and all replicates in which the organism appeared. The additional 104 samples taken in 1982 result from both ebb and flood collections for a portion of that year. Where larval stages are readily identifiable, species are divided on the list into these stages, eg. the blue crab, *Callinectes sapidus*, is listed both as "*C. sapidus* zoea" and as"*C. sapidus* megalopa".

The meroplankton collections were dominated by four general groups: 1) fish eggs, especially those of the bay anchovy, *Anchoa mitchilli*; 2) barnacle nauplii; 3) crab zoea of a variety of species; and 4) polychaete annelid larvae.

Although fish eggs were abundant in the collections, few fish larvae were taken. This scarcity was also noted among the more advanced stages of crab larvae. While advanced stages are expected to be in lower abundance than younger

stages, we suspect net avoidance was responsible for some of the difference seen in this study.

The high density of barnacle larvae was almost certainly the result of the location of the collection site. A large barnacle population exists on the rip rap forming the tunnel island from which the collecting pier extends.

Striking differences in density were observed in many species between 1982 and 1983. Of the twenty species or groups showing the highest densities in 1982, 17 were less abundant in 1983. Seven of these species or groups showed a reduction in density of an order of magnitude or greater. The reduction in abundance in 1983 compared to 1982 extends through most of the species or groups collected.

As can be seen in Figures 2 - 35 the time of first occurence and the time of peak abundance was later in 1983 than in 1982 for most species. The bay mouth was slightly warmer and less saline in 1983 than in 1982, however, we have no evidence linking this with the general phenomenon of the retarded spawning season.

Discrete depth zooplankton samples below the neuston layer are rare from shallow inshore waters. The samples reported on here appear to be unique in their extent over time in the lower Chesapeake Bay. Tables 5 and 6 show the frequency and density at depth for the most abundant mero-planktERS in 1982 and 1983, respectively.

A large body of literature exists on the vertical distribution and migration of zooplankters. Since all of our

collections were made during the day, we produced no information on diurnal vertical movement in the water column; however, it is apparent from Tables 4 and 5 that many species show uneven distributions at least during the day.

Near surface waters were dominated by fish eggs and crab zoea. Especially abundant in the surface layer were the eggs of the bay anchovy, *Anchoa mitchilli* and the zoea stages of the blue crab, *Callinectes sapidus*, and the rock crab, *Cancer irroratus*.

Near bottom water were dominated by polychaete annelid larvae, bivalve mollusk larvae and the zoea stages of several crabs, *Pinnixia*, *Pinnotheres*, *Upogebia* and *Libinia*.

A number of meroplankters appeared to be scattered throughout the water column. These forms include *Anchoa mitchilli* larvae, the zoea of the sand shrimp, *Crangon septemspinosa*, the mud crab, *Neopanope texana sayi*, and fiddler crabs, *Uca* spp. Also prominent were the megalopa stages of the blue crab, *Callinectes sapidus*, and the mud crab, *Hexapanopeus angustifrons*, as were barnacle nauplii, gastropod larvae, and spionid polychaete larvae.

Tables and Figures

Table 1. Temperature and salinity data accompanying the 1982 meroplankton samples samples at South Island, Chesapeake Bay Bridge-Tunnel. "Begin" = beginning of a sample series and "End" = end of a sample series; "F" = flood tide, "E" = ebb tide.

		Surface				Bottom			
		Temperature (C)		Salinity (o/oo)		Temperature (C)		Salinity (o/oo)	
Date		Begin	End	Begin	End	Begin	End	Begin	End
01/27/82	F	0.3	0.4	20.7	22.5	0.4	0.5	21.8	25.2
	E	0.4	0.4	23.3	21.1	0.5	0.5	25.0	21.5
02/08/82	F	---	---	----	----	---	---	----	----
	E	2.6	3.1	18.9	19.6	2.5	2.5	21.3	21.6
02/24/82	F	4.0	---	23.7	24.0	3.3	---	31.6	30.8
	E	4.7	5.0	22.8	22.5	3.2	3.8	31.8	25.3
03/09/82	F	4.1	4.1	21.2	22.1	4.0	2.8	21.8	23.0
	-	4.6	4.8	22.5	20.5	4.0	4.7	23.0	20.9
03/25/82	F	7.7	7.8	19.8	20.1	6.3	6.2	26.4	27.7
	E	8.9	8.9	19.1	19.1	6.5	7.2	27.2	22.1
04/08/82	F	7.5	7.6	22.1	21.7	7.3	7.6	18.5	21.9
	E	7.6	8.2	22.3	21.5	7.4	7.8	23.9	22.7
04/22/82	F	11.1	11.0	22.2	22.4	10.6	10.5	23.9	23.0
	E	11.7	11.8	21.2	21.1	10.0	11.3	25.7	21.8
05/06/84	F	15.3	----	19.6	----	12.4	----	27.3	----
	E	15.8	16.5	20.3	19.9	12.2	16.5	27.5	21.1

Table 1. Cont'd.

Date		Surface Temperature (C) Begin	Surface Temperature (C) End	Surface Salinity (o/oo) Begin	Surface Salinity (o/oo) End	Bottom Temperature (C) Begin	Bottom Temperature (C) End	Bottom Salinity (o/oo) Begin	Bottom Salinity (o/oo) End
05/25/82	F	20.0	19.8	21.1	22.0	19.5	18.8	22.9	23.9
	E	20.4	20.5	22.0	22.0	19.5	19.8	23.1	21.3
06/08/82	F	22.0	21.6	28.9	29.3	19.6	19.7	30.4	30.4
	E	22.2	22.2	22.1	20.7	20.4	20.4	29.2	26.4
06/23/82	F	22.7	22.8	20.1	20.3	20.8	21.5	24.8	24.1
	E	22.7	23.4	22.4	20.2	22.3	23.5	22.5	22.0
07/07/82	F	23.5	23.7	21.4	21.4	20.1	20.5	27.1	26.4
	E	24.4	24.2	21.6	21.2	20.7	21.7	25.7	24.2
07/20/82	F	26.5	26.5	28.8	21.5	25.1	24.6	22.2	22.7
	E	24.8	24.2	22.8	23.4	19.9	20.2	27.2	26.9
08/04/82	F	26.8	27.9	20.7	20.4	17.8	20.0	29.0	27.7
	E	25.8	25.5	20.1	21.0	16.5	17.2	29.4	28.7
08/18/82	F	24.8	24.6	22.1	22.2	24.2	24.0	22.4	22.1
	E	23.7	23.7	22.4	23.1	22.4	21.9	24.7	25.7
09/02/82	F	23.2	23.3	24.3	23.8	22.9	23.1	24.6	24.4
	E	22.8	22.7	23.2	24.3	21.8	21.8	27.8	27.6

Table 1. Cont'd.

Date		Surface				Bottom			
		Temperature (oC)		Salinity (o/oo)		Temperature (oC)		Salinity (o/oo)	
		Begin	End	Begin	End	Begin	End	Begin	End
09/16/82	F	24.2	24.2	23.8	23.2	23.0	24.0	25.3	23.3
	E	23.5	24.0	24.2	24.9	23.4	23.3	24.8	25.9
09/16/82	F	24.2	24.2	23.8	23.2	23.0	24.0	25.3	23.3
	E	23.5	24.0	24.2	24.9	23.4	23.3	24.8	25.9
09/29/82	F	22.0	22.0	22.3	22.0	21.7	21.6	22.6	26.4
	E	21.5	21.8	22.0	22.8	21.6	21.5	26.9	26.7
10/13/82	F		MISSING DATA				MISSING DATA		
	E								
10/27/82		14.2	14.2	24.0	22.6	14.2	14.1	29.7	29.5
11/16/82		13.1	12.3	26.5	24.6	13.0	12.4	27.3	25.4
11/30/82		11.9	11.7	25.9	25.3	11.8	11.6	26.2	25.2
12/14/82		8.1	7.4	21.1	21.5	8.2	8.6	21.8	26.2
12/29/82		9.0	8.8	22.1	23.4	8.8	8.7	22.5	23.6

Table 2. Temperature and salinity data accompanying the 1983 meroplankton samples samples at South Island, Chesapeake Bay Bridge-Tunnel. "Begin" = beginning of a sample series and "End" = end of a sample series.

Date	Surface				Bottom			
	Temperature (C)		Salinity (o/oo)		Temperature (C)		Salinity (o/oo)	
	Begin	End	Begin	End	Begin	End	Begin	End
01/13/83	6.2	6.0	22.6	22.1	6.5	6.1	23.2	22.4
01/27/83	4.0	3.9	21.3	21.9	4.1	4.0	22.3	21.4
02/15/83	4.2	4.6	20.7	20.6	3.6	3.5	23.5	21.3
03/02/83	5.9	5.7	20.9	19.7	5.8	5.7	21.3	19.9
03/15/83	8.2	8.6	18.9	18.5	6.4	7.6	27.2	20.6
03/29/83	8.3	8.6	18.8	19.8	8.0	7.7	20.3	21.2
04/13/83	11.1	11.1	17.9	19.1	10.3	10.4	20.4	19.5
04/28/83	13.8	13.8	15.8	16.0	11.3	11.6	21.6	20.7
05/12/83	15.6	15.3	21.3	21.8	13.0	13.5	29.7	29.7
05/26/83	18.7	18.6	20.7	19.5	17.1	15.2	24.5	27.1
06/09/83	20.0	20.6	21.2	20.6	16.2	18.6	27.5	21.9
06/28/83	24.9	25.7	19.5	19.2	20.2	21.1	27.1	27.1
07/12/83	24.7	26.0	18.2	16.5	22.3	24.4	23.0	17.8
07/26/83	25.2	27.1	22.2	20.3	21.4	24.1	26.9	24.1
08/09/83	27.5	27.3	25.1	22.3	24.0	24.8	24.5	24.1
08/24/83	24.5	25.0	25.6	26.0	23.9	24.0	25.8	25.0
09/09/83	26.9	26.7	24.3	24.3	25.9	26.4	24.2	24.0
09/22/83	23.3	23.2	25.7	24.1	23.2	23.5	26.5	24.4
10/07/83	21.1	20.8	24.5	24.8	20.7	20.9	25.0	23.8
10/27/83	24.3	15.7	24.3	22.5	17.1	16.5	23.3	22.0

Table 2. Cont'd.

Date	Surface				Bottom			
	Temperature (C)		Salinity (o/oo)		Temperature (C)		Salinity (o/oo)	
	Begin	End	Begin	End	Begin	End	Begin	End
11/15/83	13.1	13.1	27.6	28.5	13.2	13.4	27.0	29.4
11/22/83	12.2	12.3	25.8	25.1	12.3	12.0	25.5	25.5
12/10/83	9.7	9.3	22.8	21.4	11.4	11.4	23.4	28.6

Table 3. Frequency of occurrence and density of meroplankton taken at South Island, Chesapeake Bay Bridge-Tunnel in 1982. Total samples = 379. Species density is the average of all samples in which the species appeared. Frequency is the number of tows in which an organism appeared.

Species	Frequency	Density (#/100 cu. m.)
Ammodytes americanus larvae	15	7.975
Menidia menidia larvae	7	30.688
Scophthalmus aquosus larvae	4	43.846
Scophthalmus aquosus eggs	43	131.559
Hypsoblennius hentzi larvae	29	41.536
Anchoa mitchilli larvae	91	593.500
Anchoa mitchilli eggs	126	35,530.500
Chaetodipterus faber larvae	1	1.531
Gobiesox strumosus larvae	2	3.407
Gobiosoma bosci larvae	51	53.574
Tautoga onitis larvae	1	5.923
Lophius americanus larvae	1	10.554
Bairdiella chrysoura eggs	15	221.259
Cynoscion regalis larvae	8	26.459
Menticirrhus saxatilis larvae	1	21.297
Pogonias cromis eggs	5	22.266
Trinectes maculatus larvae	12	16.948
Trinectes maculatus eggs	80	843.679
Hippocampus sp.	1	3.822
Syngnathus fuscus	5	5.768
Sphoeroides maculatus	1	6.019
Fish egg, unidentified	87	400.886
Fish larvae, unidentified	9	16.354
Ophiurae sp. larvae	2	56.466
Lucifer faxoni larvae	51	52.943
Penaeus sp. zoea	2	9.271
Paleomonidae, unidentified zoea	38	108.719
Alpheus sp. zoea	22	41.762
Ogyrides sp. zoea	15	59.851
Hippolyte sp. zoea	1	1.359
Crangon septemspinosa zoea	160	637.402
Callianassa sp. zoea	79	268.710
Upogebia affinis zoea	140	1,696.430
Naushonia crangonoides zoea	3	19.334
Shrimps, unidentified zoea	5	61.911
Euceramus sp. zoea	39	228.395
Polyonyx gibbesi zoea	85	101.381
Porcellanidae, unidentified zoea	2	25.312
Pagurus sp. zoea	92	250.634
Emerita talpoida zoea	43	79.195
Lepidopa websteri zoea	2	16.230

Table 3. Cont'd.

Species	Frequency	Density (#/100 cu. m.)
Callinectes sapidus zoea	145	4,698.590
Callinectes sapidus megalopa	34	184.481
Ovalipes ocellatus zoea	73	569.231
Portunus gibbesii zoea	7	534.092
Portunus spinimanus zoea	16	201.819
Portunus sp. zoea	25	1,279.160
Cancer irroratus zoea	32	6,152.010
Eurypanopeus depressus zoea	7	32.697
Hexapanopeus angustifrons zoea	85	658.077
Hexapanopeus angustifrons megalopa	14	74.212
Neopanope texana sayi zoea	142	1,417.530
Neopanope sp. megalopa	1	36.158
Xanthidae unidentified zoea	26	316.377
Pinnixa chaetopterana larvae	100	927.076
Pinnixa chaetopterana megalopa	1	43.390
Pinnixa cylindrica zoea	42	466.459
Pinnixa sayana zoea	114	419.294
Pinnixa sp. zoea	9	64.106
Pinnotheres maculatus zoea	54	126.545
Pinnotheres ostreum zoea	123	1,122.150
Pinnotheres ostreum megalopa	22	135.826
Pinnotheres ostreum crab stage	14	29.716
Uca spp. zoea	115	889.014
Libinia sp. zoea	51	301.170
Libinia sp. megalopa	5	673.533
Zoea, unidentified	9	96.525
Barnacle nauplii	279	8,699.750
Barnacle cyprii	11	70.432
Squilla empusa zoea	61	63.835
Ampharetidae, unidentified	3	8.094
Asabellides oculata	51	103.213
Mediomastus ambiseta	5	20.410
Chrysopetalidae, unidentified	18	88.979
Paleanotus heteroseta	2	29.329
Goniadidae, unidentified	1	30.613
Hesionidae, unidentified	12	949.629
Nephytidae, unidentified	4	54.909
Nereidae, unidentified	110	837.775
Nereis succinea	2	3.624
Pebtinaria gouldi)	2	69.262
Opheliidae, unidentified	6	56.942
Phyllodocidae, unidentified	17	180.796
Paranaitis speciosa	12	23.429
Polynoidae, unidentified	30	194.839
Polydora sp.	64	922.717
Paraprionospio pinnata	2	18.703

Table 3. Cont'd.

Species	Frequency	Density (#/100 cu. m.)
Spiophanes bombyx	2	10.136
Spionidae, unidentified	238	3,085.240
Syllidae, unidentified	7	80.544
Autolytus sp.	14	2,335.810
Polychaeta, unidentified	124	602.387
Echinoderm larva, unidentified	2	20.700
Nudibranchia, unidentified	6	25.755
Oligochaeta	3	29.836
Phoronidae, unidentified	65	318.994
Tunicate larvae, unidentified	3	66.538
Nematoda, unidentified	8	46.962
Solenidae, unidentified	30	101.343
Bivalves, unidentified	183	809.434
Ilyanassa sp.	4	215.075
Gastropoda, unidentified	184	1,320.150
Loligo sp. larvae	3	49.587

Table 4. Frequency of occurrence and density of meroplankton taken at South Island, Chesapeake Bay Bridge-Tunnel in 1983. Total samples = 275. Species density is the average of all samples in which the species appeared. Frequency is the number of tows in which the organism appeared.

Species	Frequency	Density (#/100 cu. m.)
Ammodytes americanus	1	53.084
Menidia menidia larvae	2	5.985
Scophthalmus aquosus larvae	1	2.993
Scophthalmus aquosus eggs	7	24.915
Hypsoblennius hentzi larvae	38	281.535
Anchoa mitchilli larvae	41	280.937
Anchoa mitchilli eggs	84	4653.300
Gobiesox strumosus larvae	3	4.514
Gobiosoma bosci larvae	19	69.779
Tautoga onitis larvae	1	12.260
Bairdiella chrysoura eggs	19	187.905
Cynoscion regalis larvae	3	24.421
Trinectes maculatus larvae	5	7.745
Trinectes maculatus eggs	61	723.413
Hippocampus sp.	1	6.280
Fish eggs, unidentified	46	2007.910
Fish larvae, unidentified	6	5.920
Ophiurae sp.	2	245.206
Lucifer sp. zoea	41	314.181
Penaeus sp.	1	1.149
Paleomonidae, unidentified zoea	64	107.451
Alpheus sp. zoea	18	325.469
Ogyrides sp. zoea	1	4.544
Hippolyte sp. zoea	1	28.677
Crangon septemspinosa	172	3252.590
Callianassa sp. zoea	41	342.792
Upogebia affinis zoea	80	538.482
Naushonia crangonoides zoea	3	6.845
Shrimps, unidentified	6	2.936
Euceramus sp. zoea	63	103.697
Polyonyx gibbesii zoea	10	43.974
Pagurus sp. zoea	75	236.338
Emerita talpoida zoea	20	74.708
Callinectes sapidus zoea	104	4388.360
Callinectes sapidus megalopa	19	238.359
Ovalipes ocellatus zoea	20	70.104
Portunus sp. zoea	2	109.018
Cancer irroratus zoea	38	472.196
Hexapanopeus angustifrons zoea	74	429.745
Hexapanopeus angustifrons megalopa	3	16.380
Neopanope texana sayi zoea	96	376.065

Table 4. Cont'd.

Species	Frequency	Density (#/100 cu. m.)
Neopanope sp. zoea	4	34.171
Xanthidae, unidentified zoea	7	268.590
Pinnixa chaetopterana zoea	63	386.653
Pinnixa cylindrica zoea	26	185.926
Pinnixa sayana zoea	77	245.491
Pinnotheres maculatus zoea	36	78.668
Pinnotheres ostreum zoea	64	378.964
Pinnotheres ostreum megalopa	5	104.052
Pinnotheres ostreum crab stage	20	53.166
Uca spp. zoea	74	1428.300
Libinia sp. zoea	8	30.390
Zoea, unidentified	6	292.700
Squilla empusa zoea	40	144.591
Barnacle nauplius	244	17842.900
Barnacle cypris	48	357.393
Ampharetidae, unidentified	24	259.238
Asabellides oculata	1	57.355
Mediomastus ambiseta	30	287.728
Goniadidae, unidentified	2	6.446
Nephytidae, unidentified	2	105.936
Nereidae, unidentified	45	178.302
Pectinaria gouldii	3	55.456
Phyllodocidae, unidentified	3	96.735
Paranaitis speciosa	2	4.526
Polynoidae, unidentified	13	82.667
Polydora sp.	8	71.703
Spionidae, unidentified	170	587.093
Syllidae, unidentified	35	305.647
Autolytus sp.	3	11.121
Polychaeta, unidentified	37	201.635
Nudibranchs, unidentified	5	44.800
Oligochaeta, unidentified	2	11.905
Phoronidae, unidentified	12	25.915
Solenidae, unidentified	4	17.979
Bivalves, unidentified	108	377.521
Gastropoda, unidentified	105	557.816
Loligo sp.	1	12.561

Table 5. Frequency and average density (number/100 cu. m.) by depth for the most abundant meroplankters in 1982.

Species	Neuston		Surface-1m		Bottom+1m		Benthic	
	Freq.	Density	Freq.	Density	Freq.	Density	Freq.	Density
Anchoa mitchilli eggs	22	168,067	45	11,507	39	4,757	20	3,800
Anchoa mitchilli larvae	11	1,161	27	493	38	469	15	674
Gobiosoma bosci larvae	2	8	12	33	25	46	12	98
Bairdiella chrysoura eggs	1	2,472	9	23	4	97	1	250
Trinectes maculatus eggs	16	3,201	38	323	19	120	7	243
fish eggs, unidentified	21	377	21	61	39	43	6	104
Crangon septemspinosa zoea	23	212	35	95	55	353	48	1,561
Upogebia affinis zoea	19	1,894	41	821	53	2,051	27	2,192
Callinectes sapidus zoea	21	19,949	52	2,398	49	2,287	23	1,115
Callinectes sapidus megalopa	3	6	10	128	17	256	4	157
Portunus sp. zoea	4	5,715	12	666	2	15	7	156
Cancer irroratus zoea	9	21,400	12	197	11	172	0	0
Hexapanopeus angustifrons zoea	18	1,243	33	707	20	296	14	306
Hexapanopeus angustifrons megalopa	1	7	1	7	9	82	3	95
Neopanope texana sayi zoea	24	2,867	33	588	56	1,305	29	1,379
Pinixa chaetoperana zoea	9	138	25	81	52	1,569	14	560
Pinixa cylindrica zoea	8	1,880	7	31	23	159	4	171
Pinixa sayana zoea	12	1,227	34	158	43	367	25	478
Pinnotheres ostreum zoea	15	649	38	140	45	2,374	25	646
Uca spp. zoea	17	2,210	35	464	47	933	16	287
Libinia spp. zoea	4	10	7	11	23	391	17	368
barnacle nauplii, unidentified	50	1,901	93	4,270	50	1,901	93	4,270
bivalve larvae, unidentified	24	95	52	462	24	95	52	462
gastropod larvae, unidentified	24	1,884	50	1,033	24	1,884	50	1,033
spionid polychaete larvae	30	219	89	1,327	30	219	89	1,327
nereid polychaete larvae	5	308	27	143	5	308	27	143
Polydora sp. larvae	8	65	36	220	8	65	36	220
Autolytus sp. larvae	1	7	1	196	1	7	1	196

Table 6. Frequency and average density (number/100 cu. m.) by depth for the most abundant meroplankters in 1983.

Species	Neuston		Surface-1m		Bottom+1m		Benthic	
	Freq.	Density	Freq.	Density	Freq.	Density	Freq.	Density
Anchoa mitchilli eggs	21	7,478	234	3,988	21	1,407	19	5,923
Anchoa mitchilli larvae	8	66	10	72	12	232	11	681
Gobiosoma bosci larvae	0	0	3	5	8	52	8	112
Bairdiella chrysoura eggs	2	785	10	148	6	55	1	29
Trinectes maculatus eggs	15	2,572	20	100	13	68	13	205
fish eggs, unidentified	7	12,587	13	227	4	7	0	0
Crangon septemspinosa zoea	41	7,852	46	1,768	44	1,507	41	2,191
Upogebia affinis zoea	13	130	26	322	22	438	19	1,232
Callinectes sapidus zoea	28	7,595	27	2,016	25	2,940	24	4,823
Callinectes sapidus megalopa	2	295	1	14	9	156	7	361
Portunus sp. zoea	1	48	0	0	0	0	1	170
Cancer irroratus zoea	8	932	11	18	10	232	9	884
Hexapanopeus angustifrons zoea	11	553	24	407	21	364	18	462
Hexapanopeus angustifrons megalopa	0	0	1	6	2	22	0	0
Neopanope texana sayi zoea	18	104	29	149	25	373	24	857
Pinixa chaetoperana zoea	5	90	14	40	24	401	20	686
Pinixa cylindrica zoea	6	702	14	25	6	45	0	0
Pinixa sayana zoea	5	56	24	31	25	215	23	543
Pinnotheres ostreum zoea	7	109	16	110	21	403	20	663
Uca spp. zoea	13	1,082	23	374	20	1,735	18	2,685
Libinia spp. zoea	0	0	5	5	2	23	1	171
barnacle nauplii, unidentified	60	40,046	68	6,686	59	8,818	57	17,123
bivalve larvae, unidentified	10	975	19	55	44	293	35	489
gastropod larvae, unidentified	14	125	34	225	41	1,052	16	378
spionid polychaete larvae	23	1,709	42	121	58	591	47	449
nereid polychaete larvae	3	37	7	15	20	90	15	400
Polydora sp. larvae	8	72	0	0	0	0	0	0
Autolytus sp. larvae	1	30	0	0	2	2	0	0

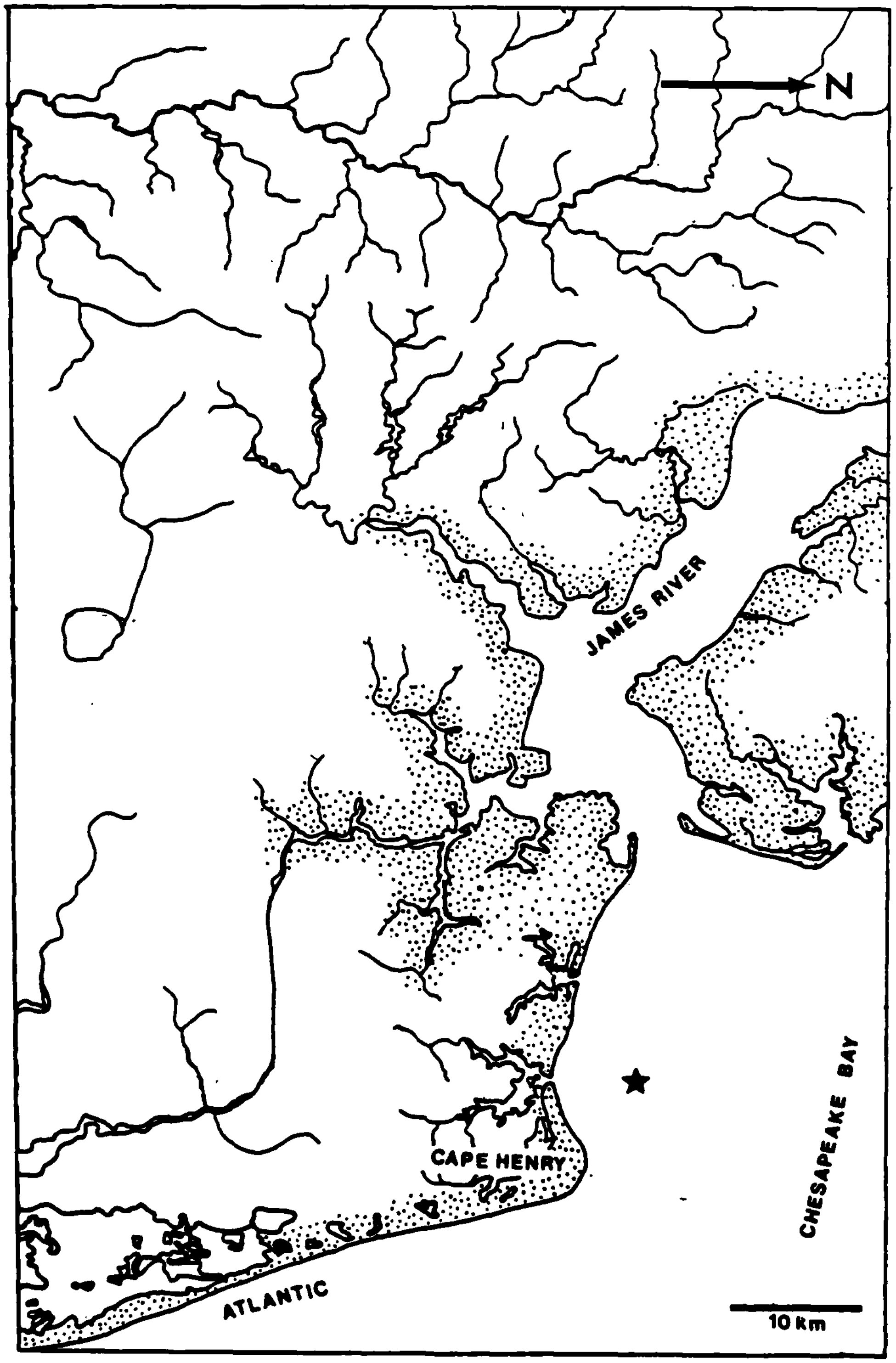

Figure 1. Location of collection site (star) on the South Island of the Chesapeake Bay Bridge-Tunnel.

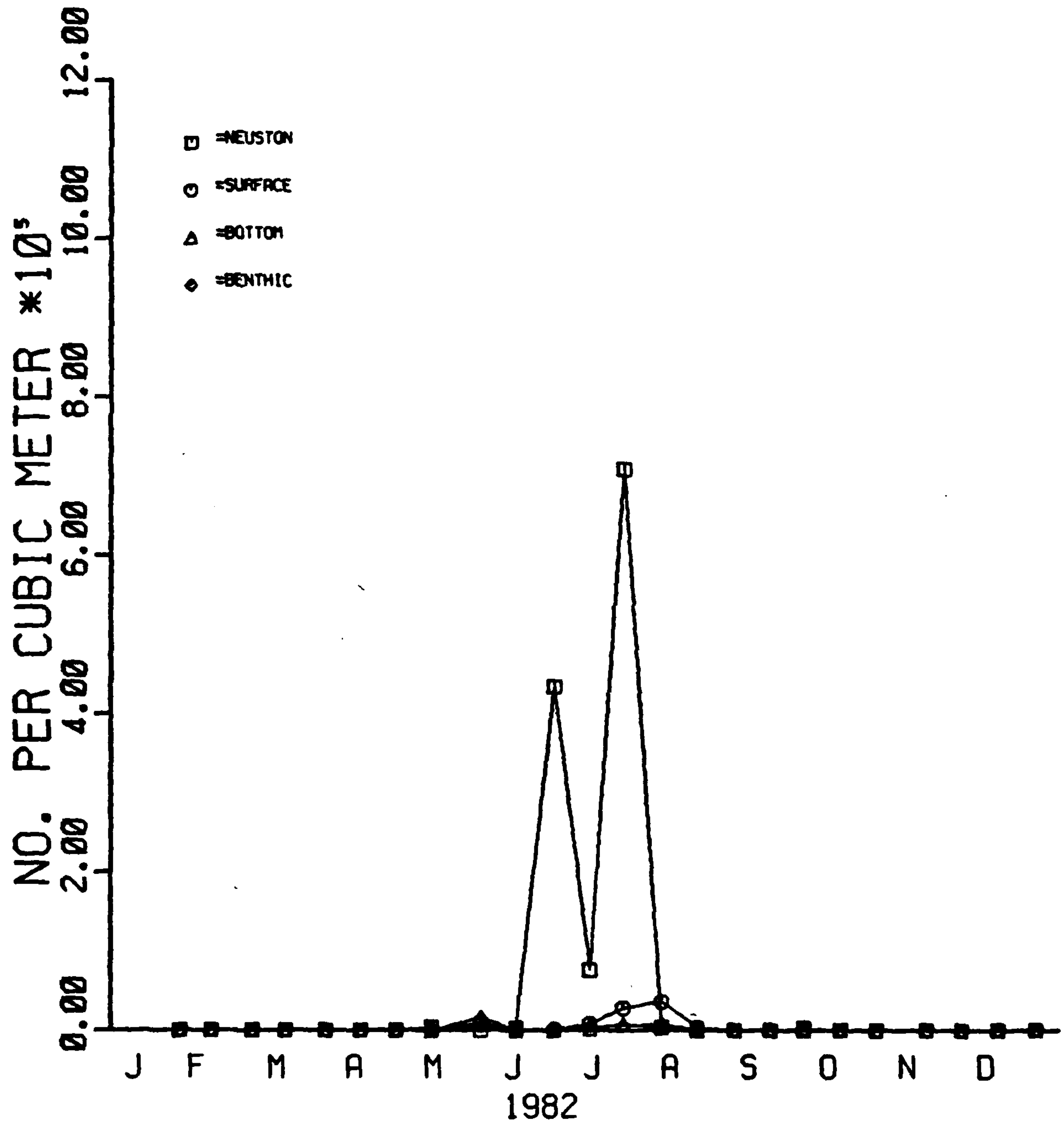

Figure 2. Density of Anchoa mitchilli eggs by depth by semimonthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

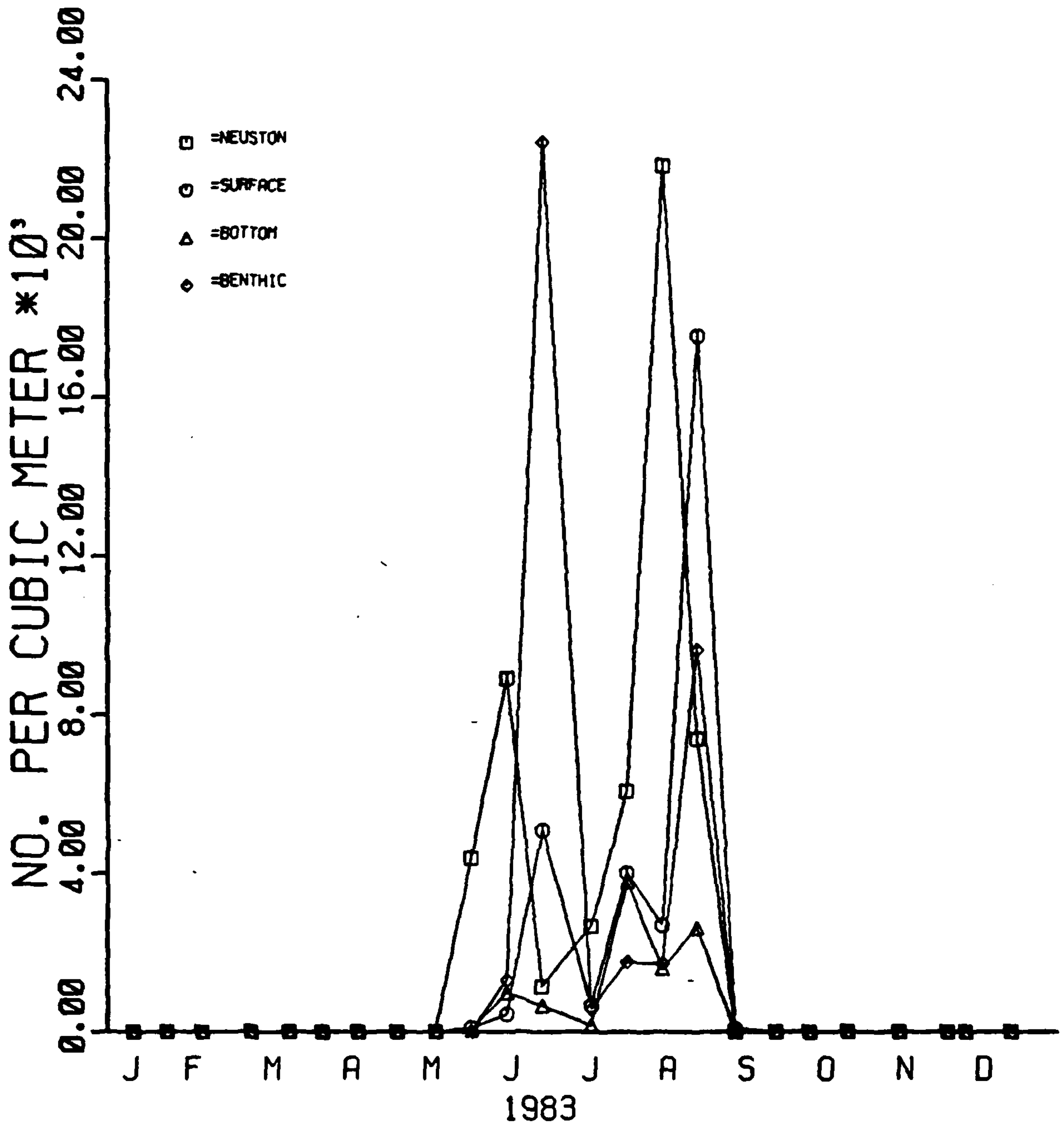

Figure 3. Density of Anchoa mitchilli eggs by depth by semimonthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

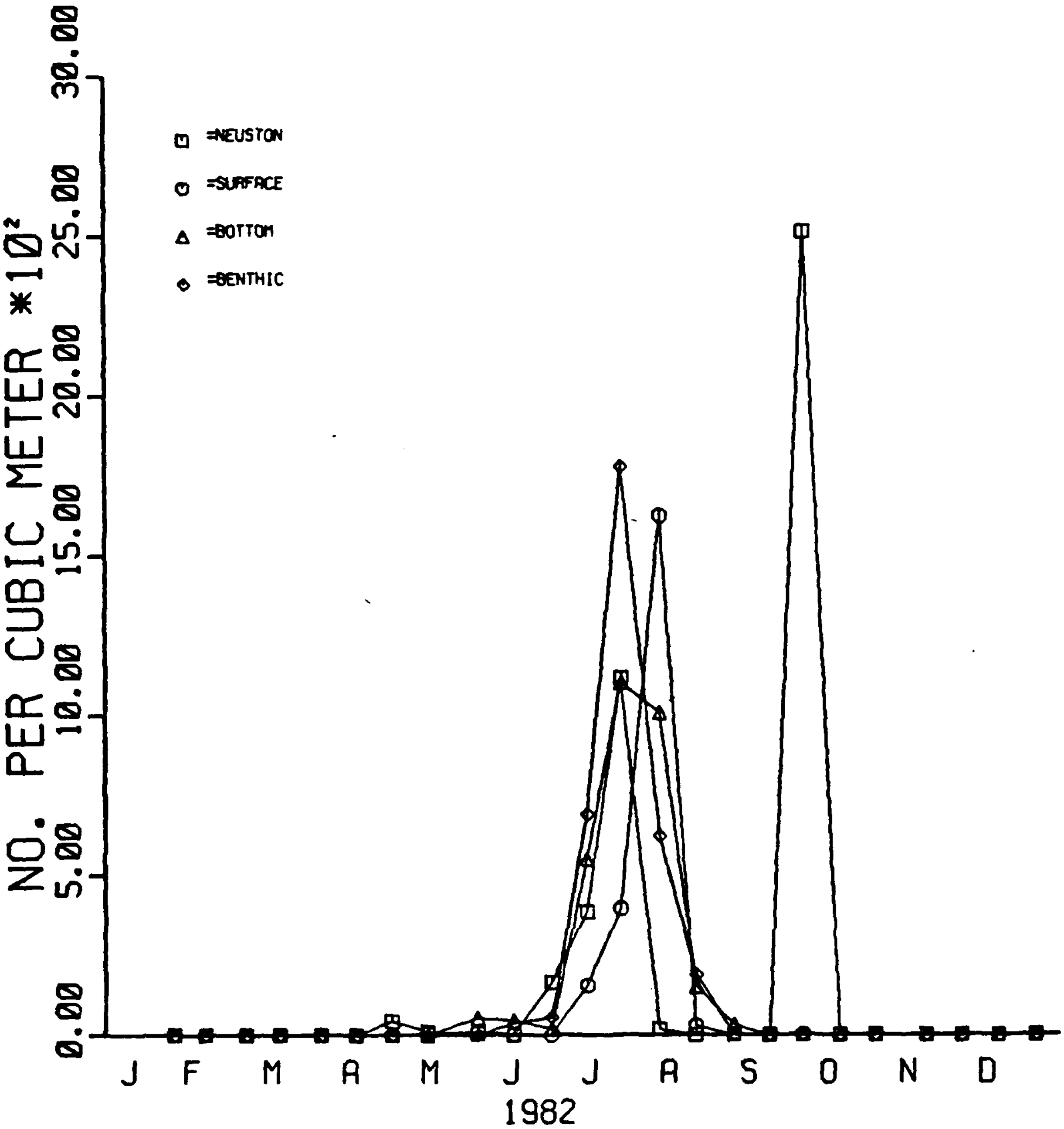

Figure 4. Density of Anchoa mitchilli larvae by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

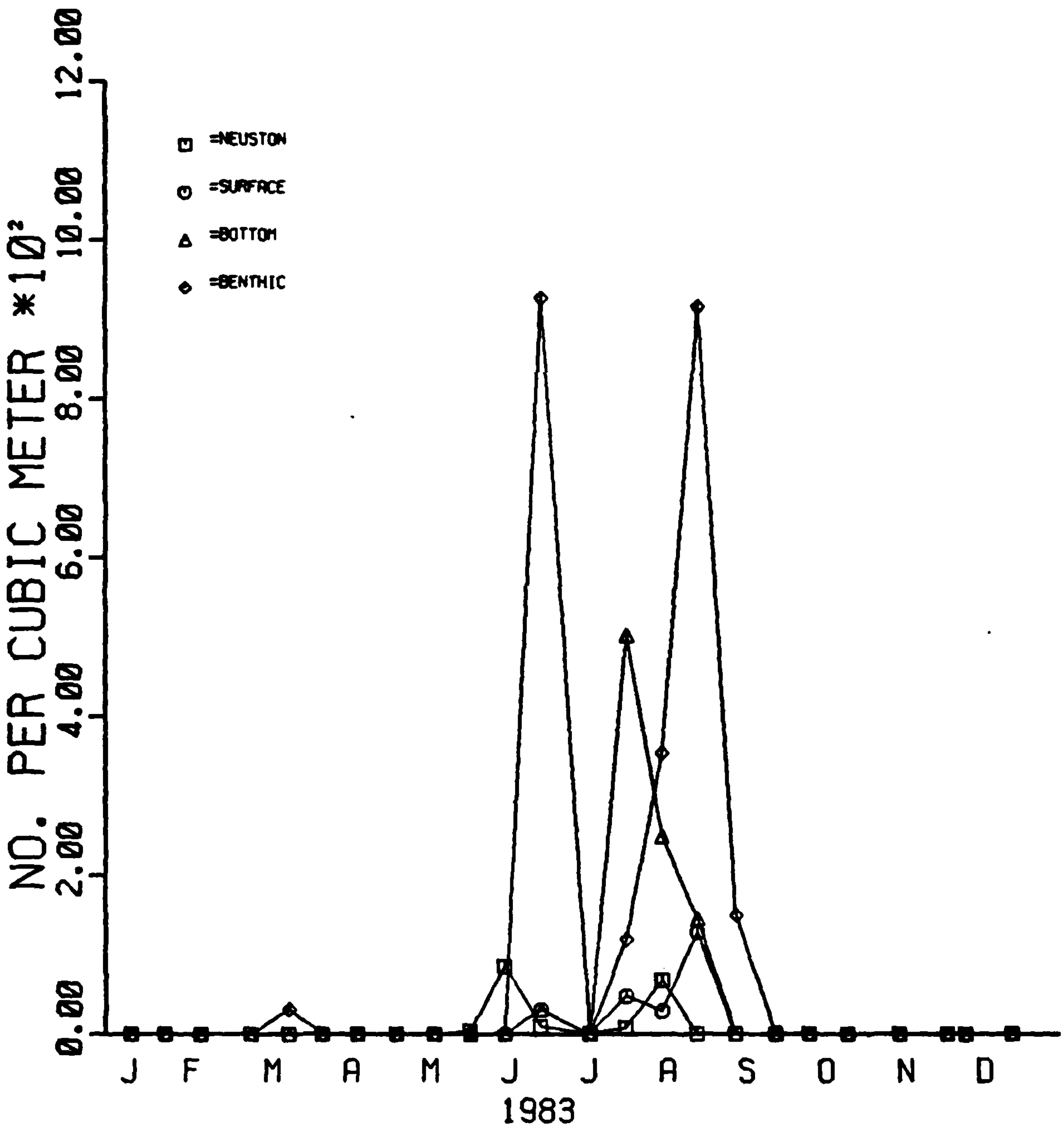

Figure 5. Density of *Anchoa mitchilli* larvae by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

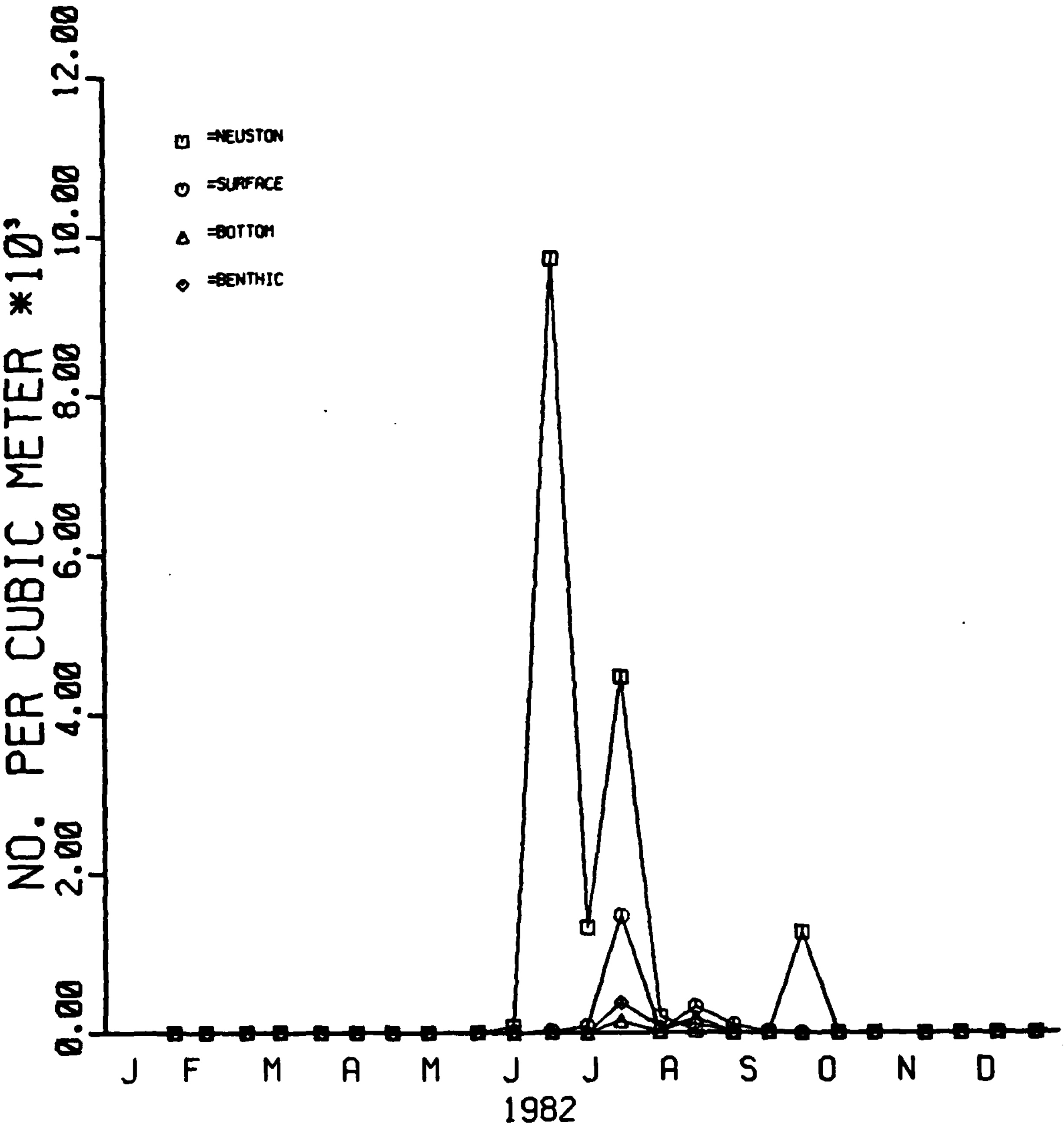

Figure 6. Density of Trinectes maculatus eggs by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

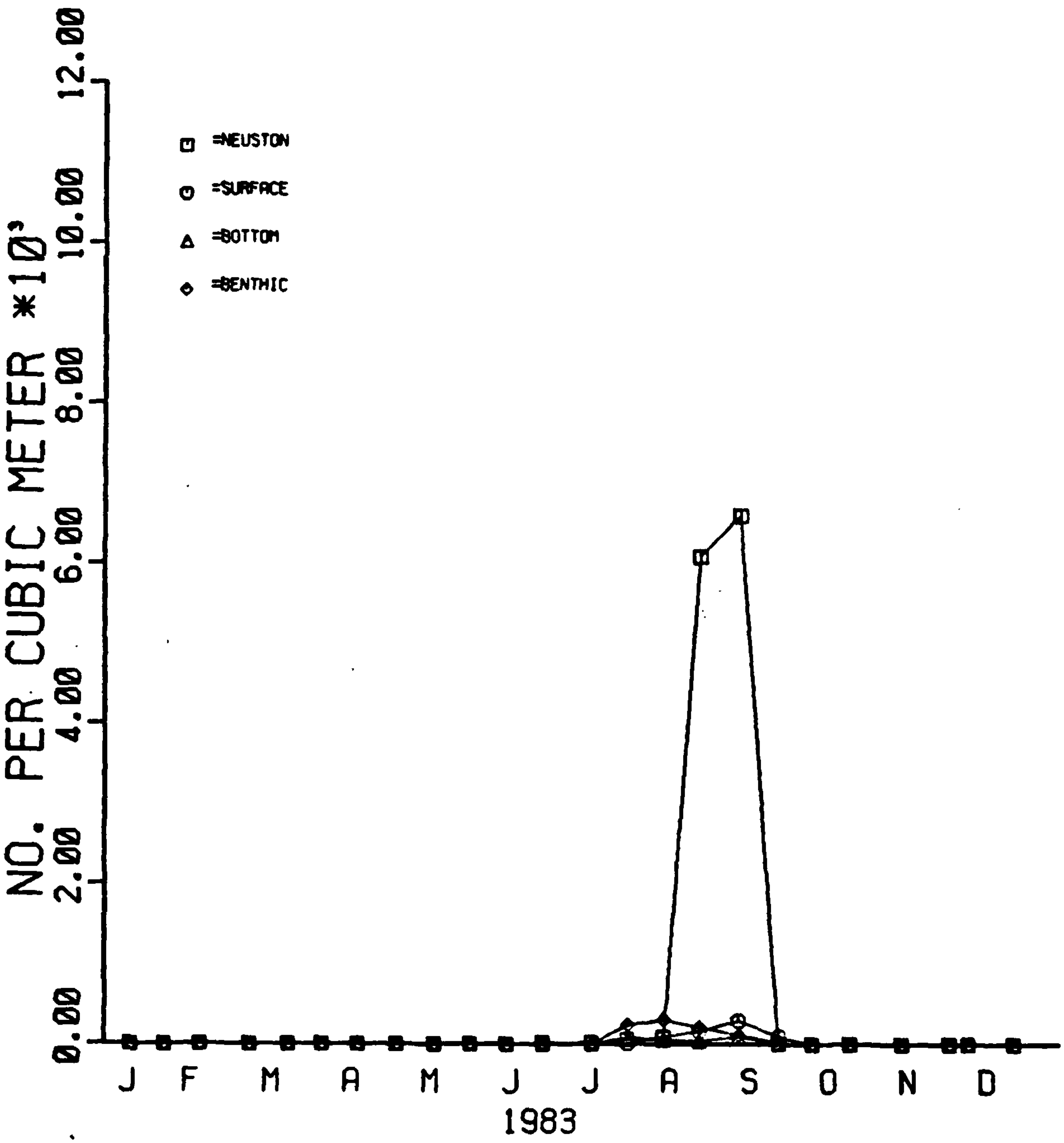

Figure 7. Density of Trinectes maculatus eggs by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

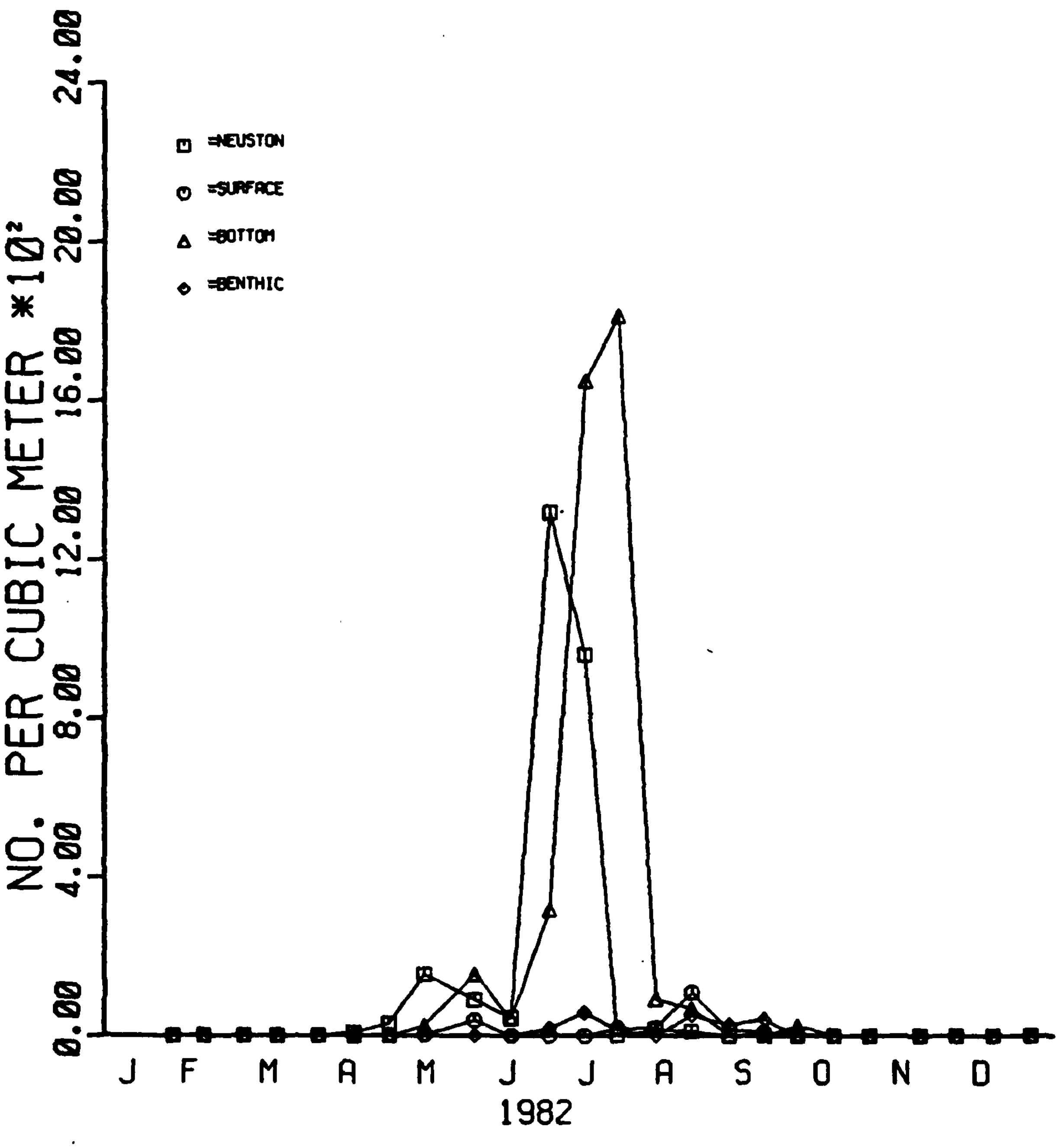

Figure 8. Density of unidentified fish eggs by depth by semimonthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

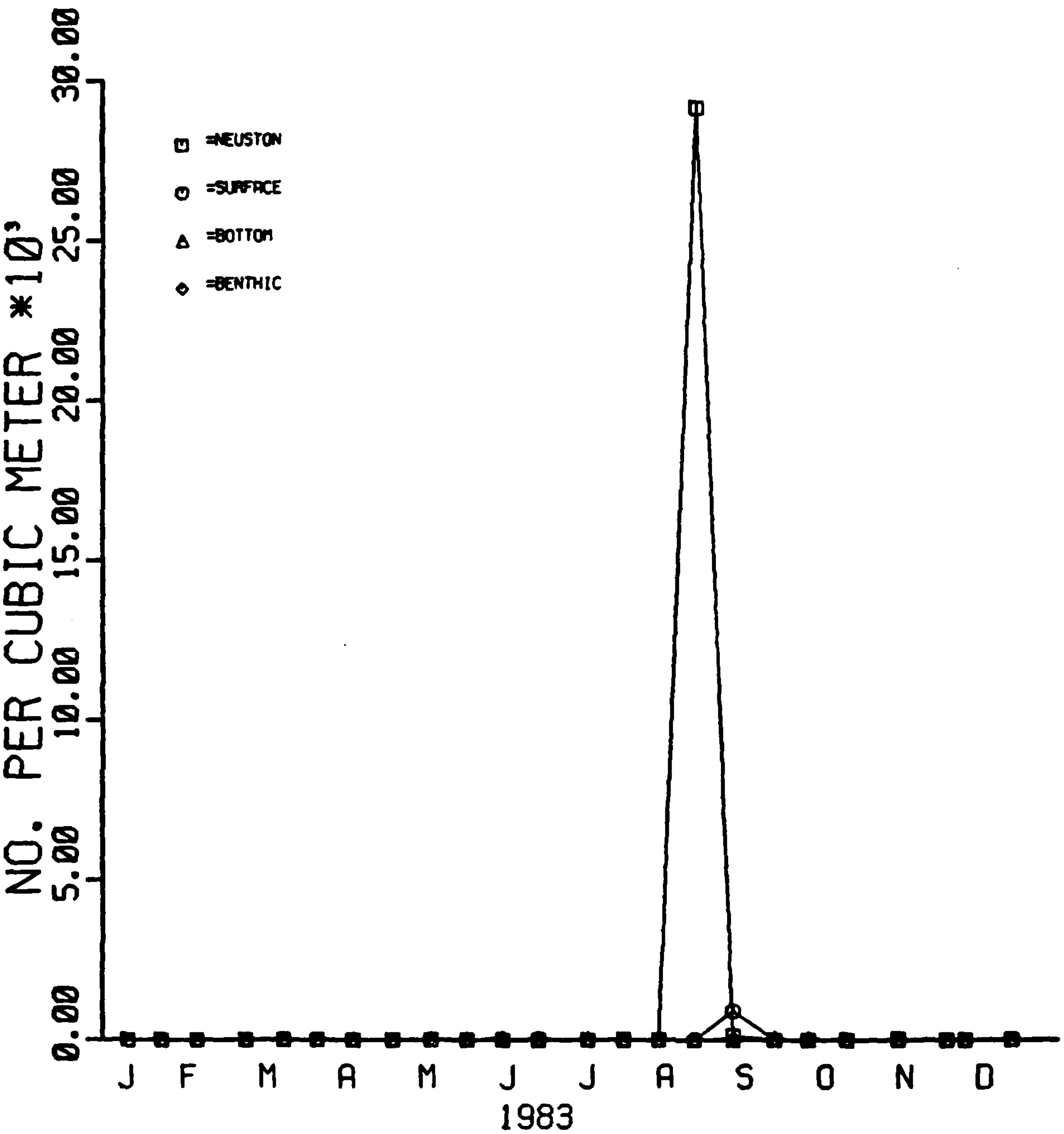

Figure 9. Density of unidentified fish eggs by depth by semimonthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

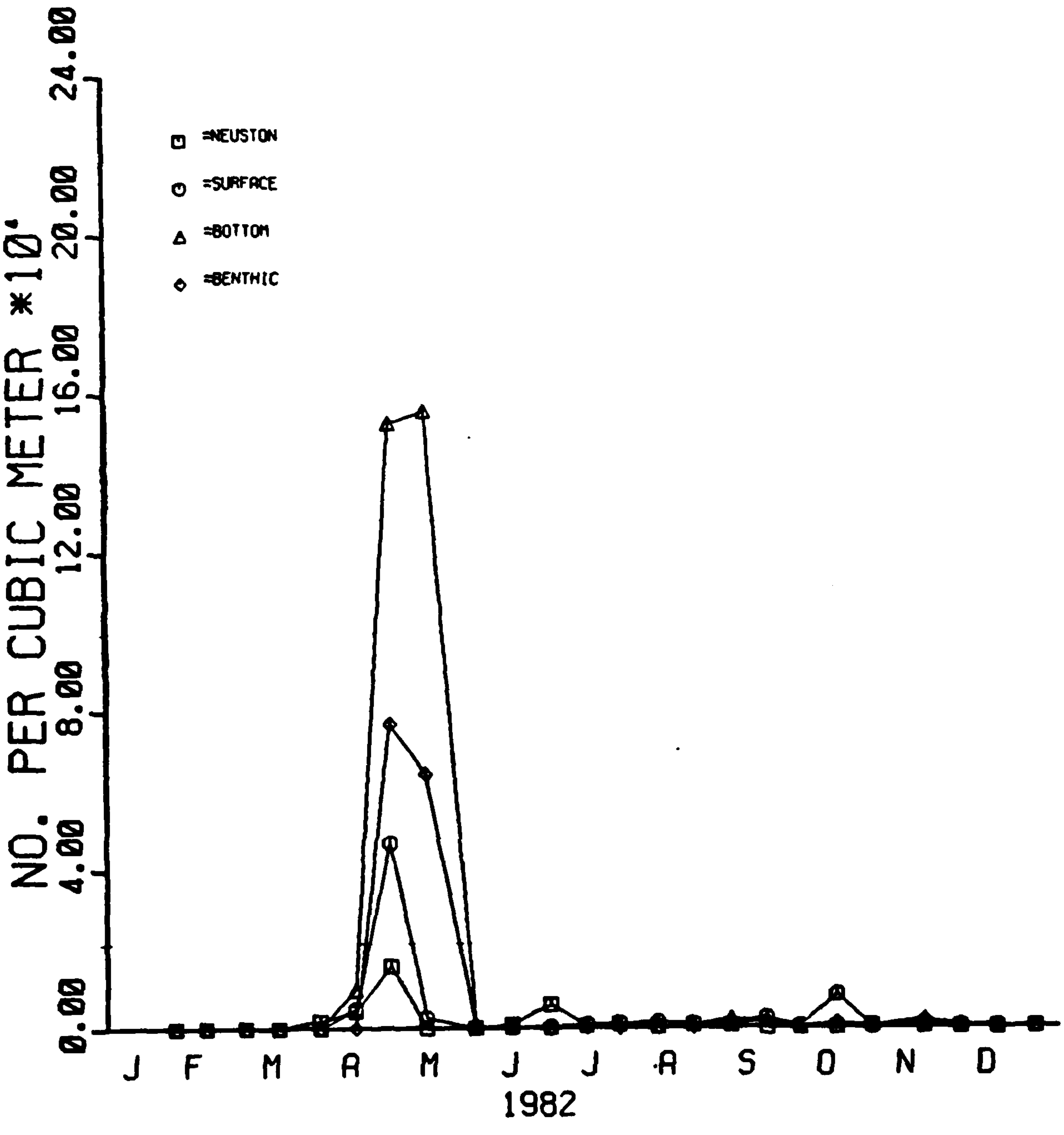

Figure 10. Density of barnacle nauplii by depth by semimonthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

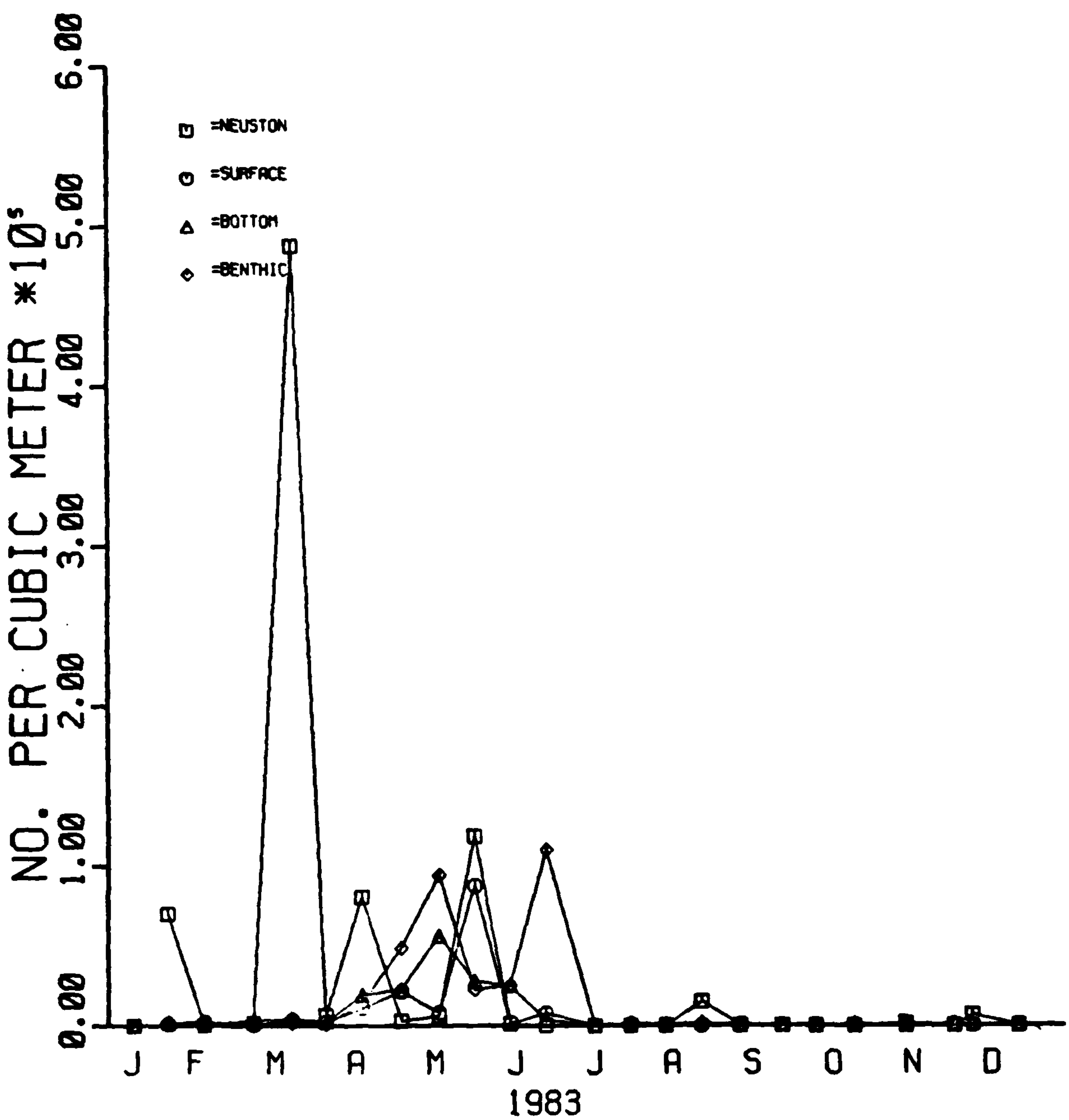

Figure 11. Density of barnacle nauplii by depth by semimonthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

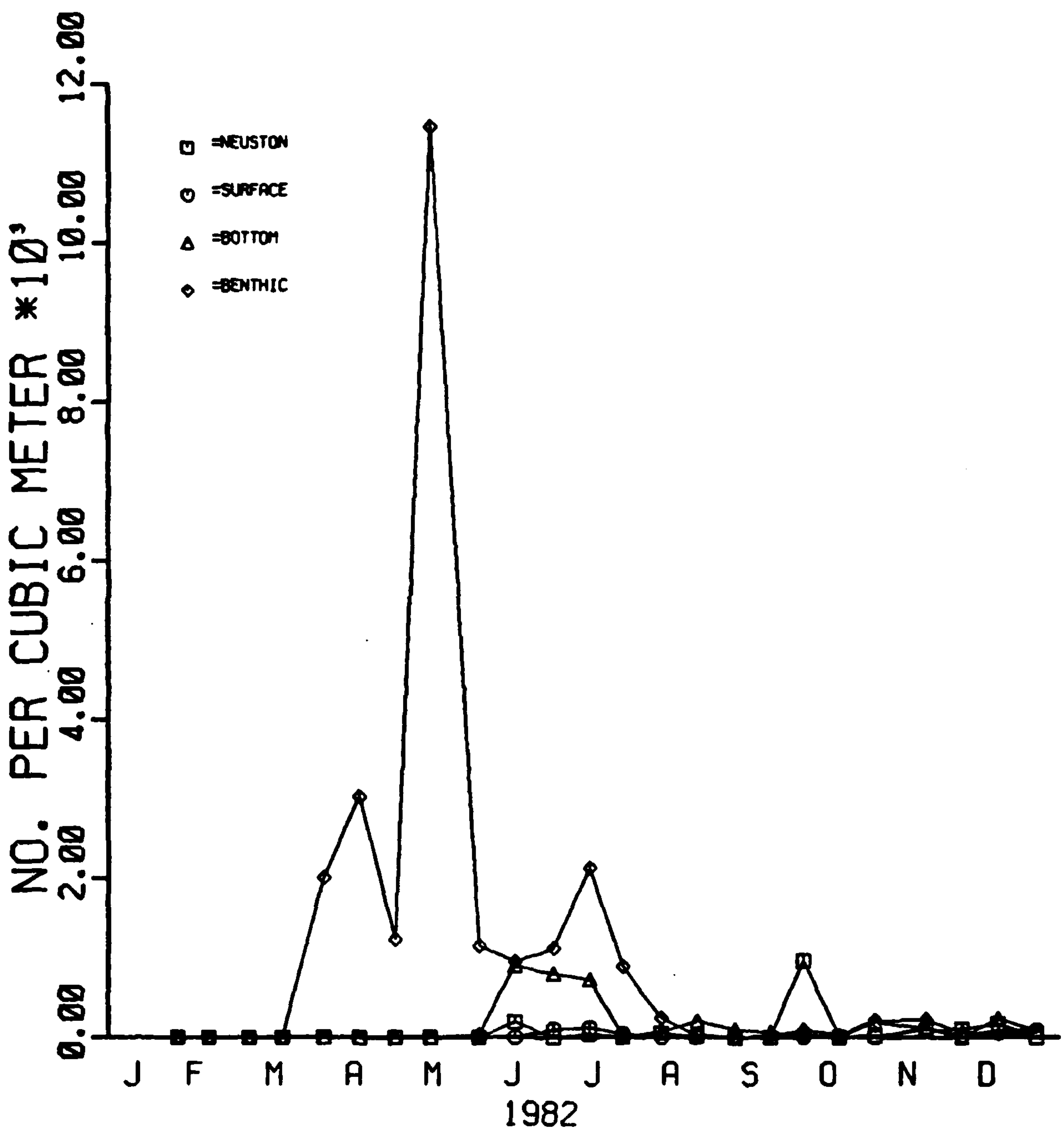

Figure 12. Density of Crangon septemspinosa zoea by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

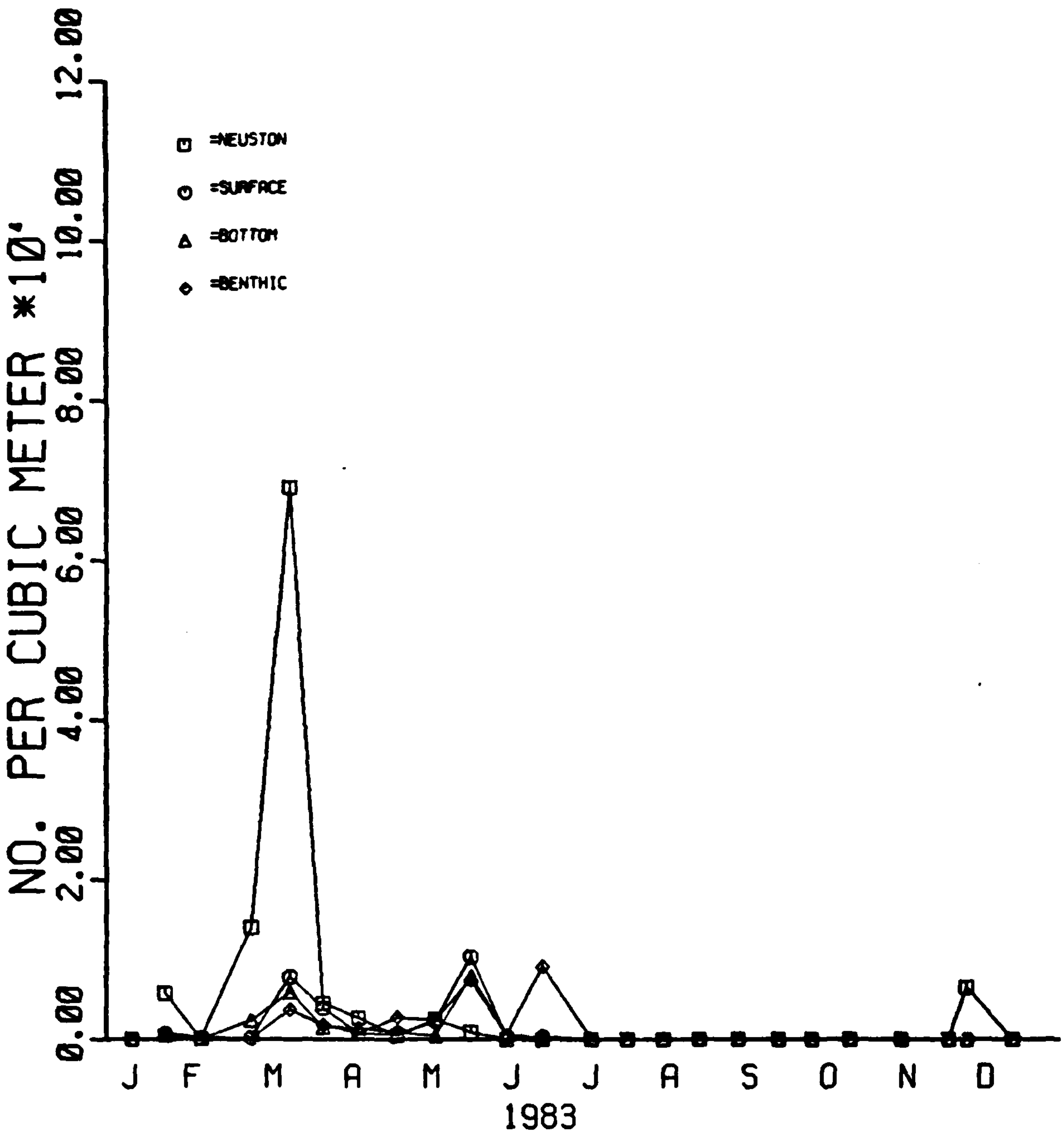

Figure 13. Density of Crangon septemspinosa zoea by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

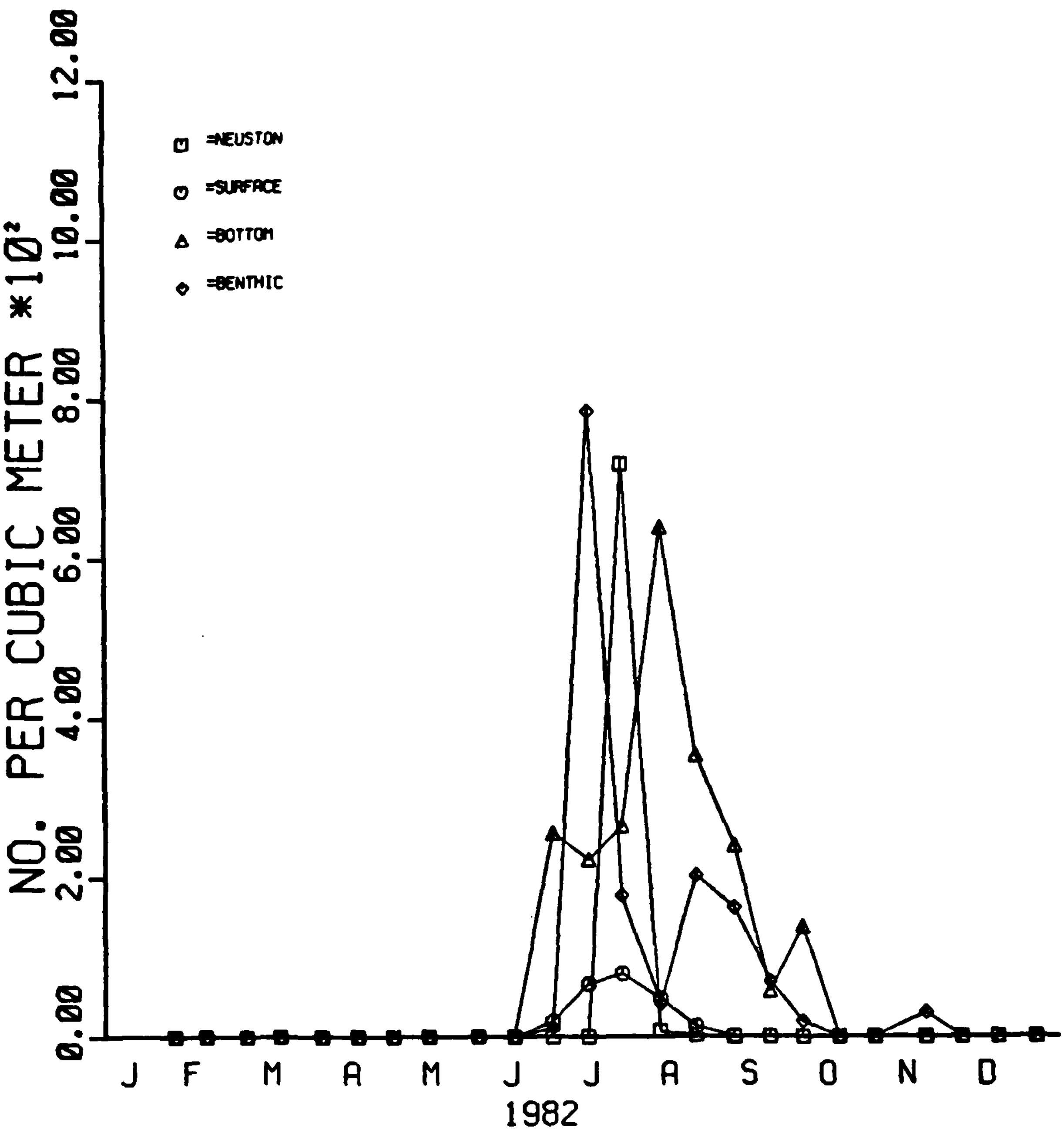

Figure 14. Density of Callianassa sp. zoea by depth by semimonthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

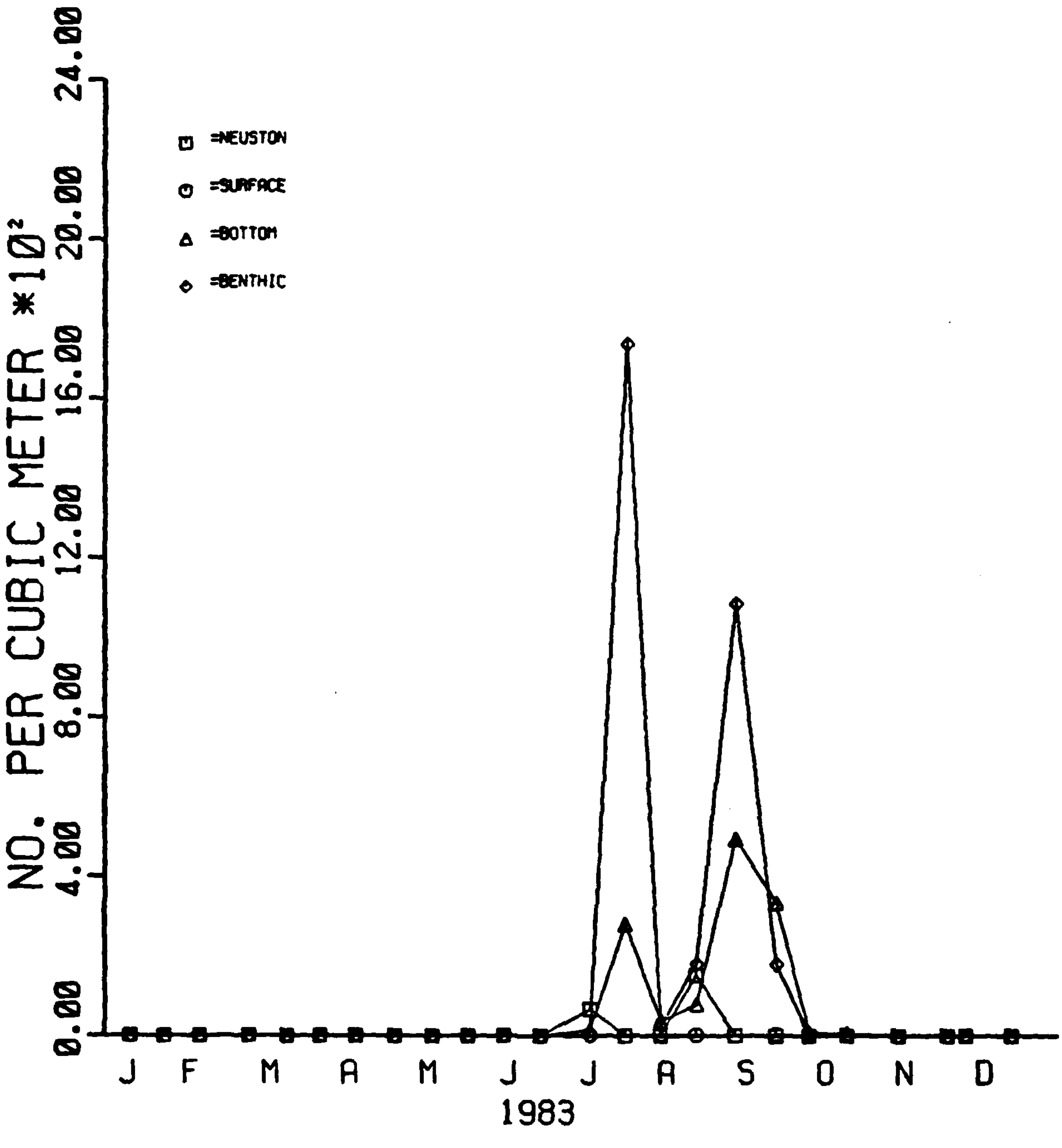

Figure 15. Density of Callianassa sp. zoea by depth by semimonthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

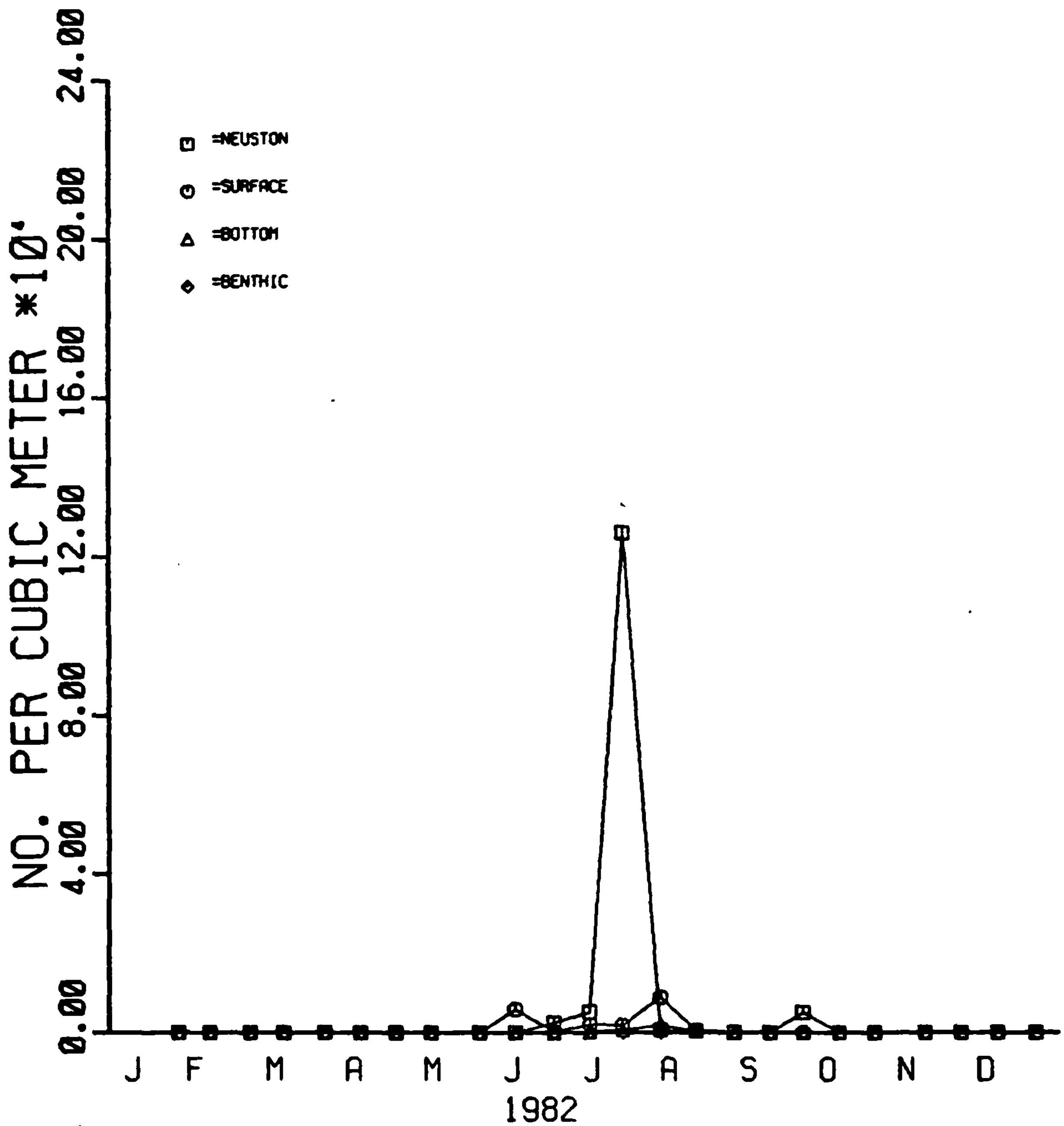

Figure 16. Density of Callinectes sapidus zoea by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

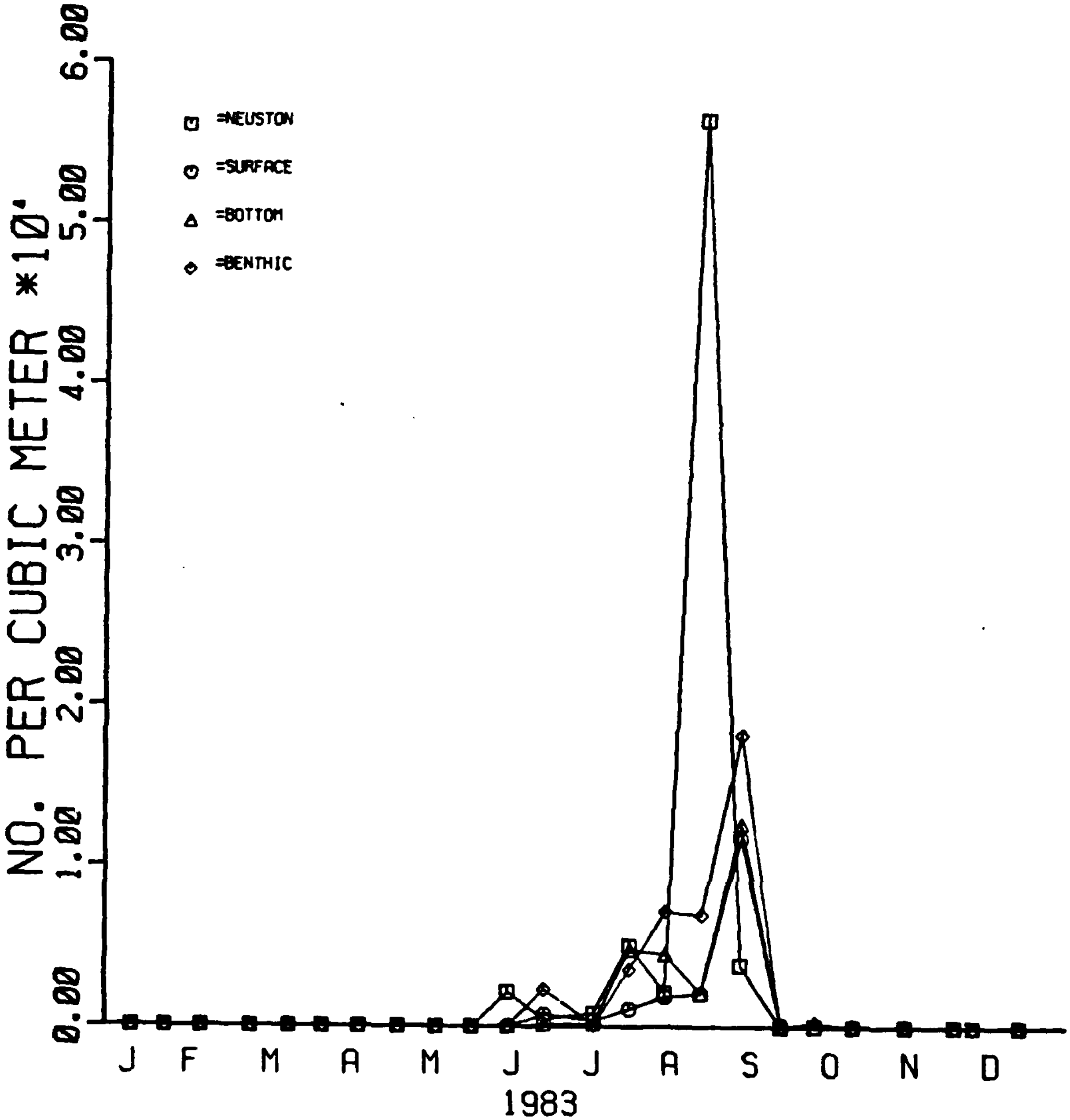

Figure 17. Density of Callinectes sapidus zoea by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

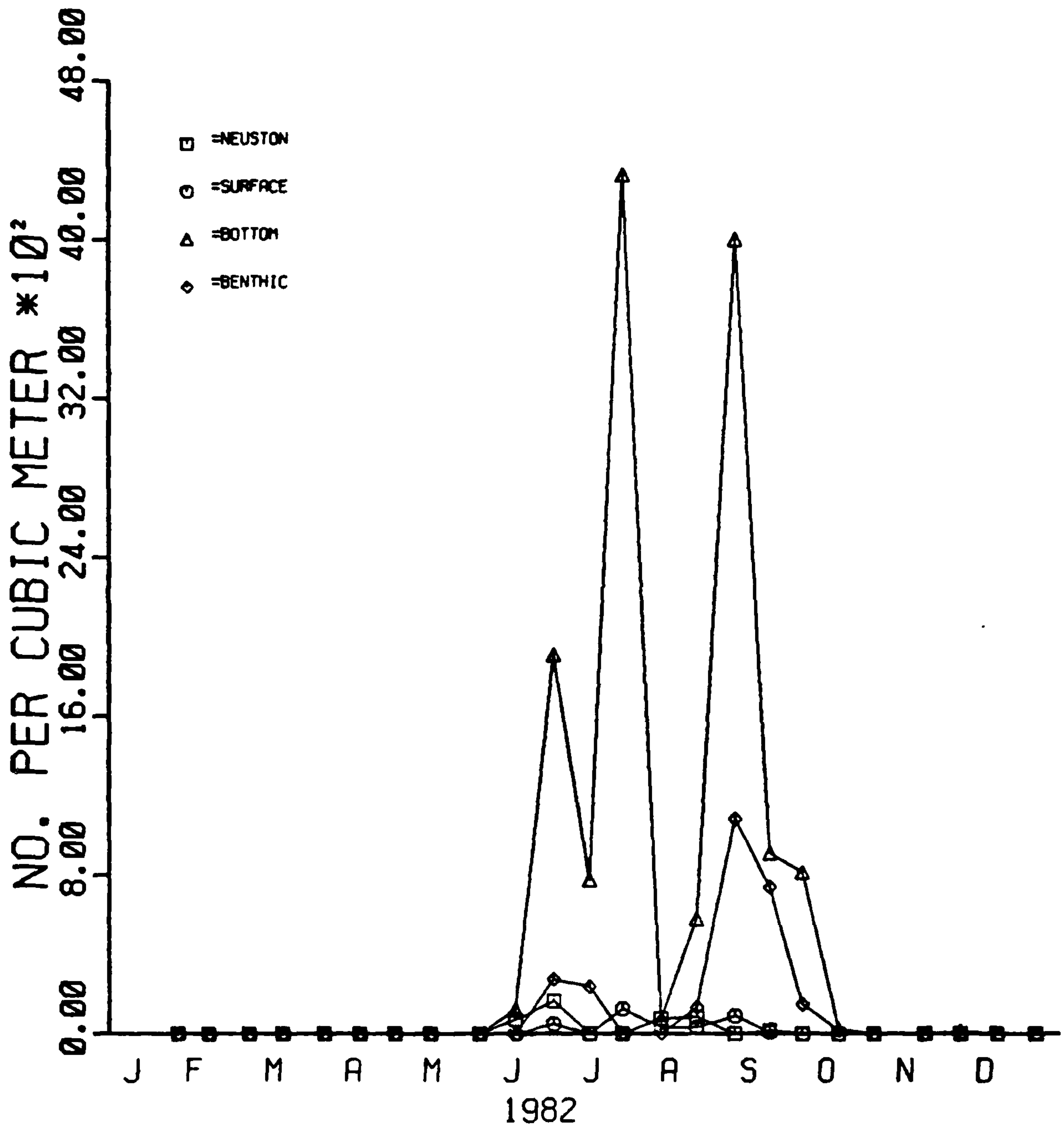

Figure 18. Density of Pinnixa chaetopterana zoea by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

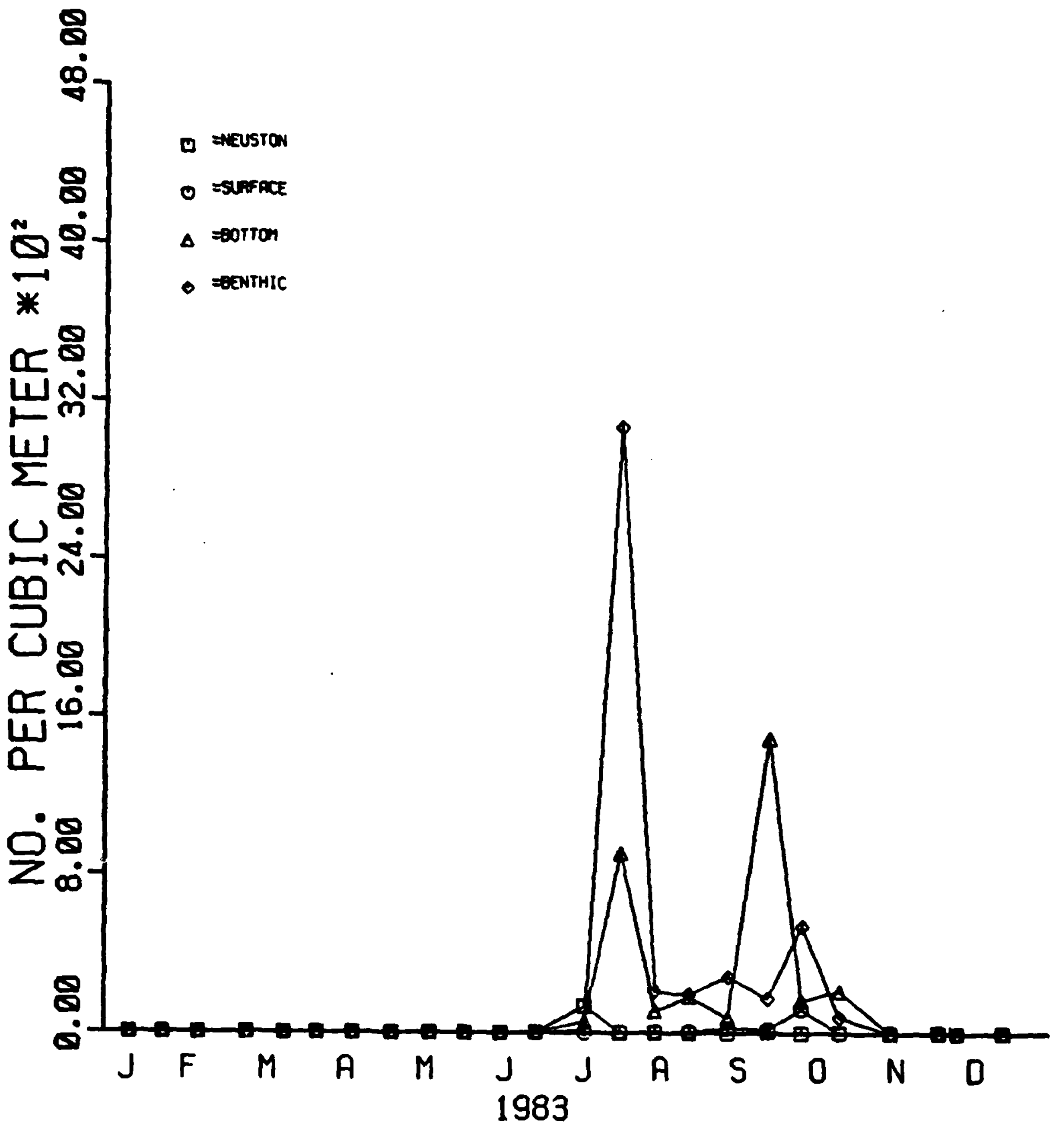

Figure 19. Density of Pinnixa chaetopterana zoea by depth by semimonthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

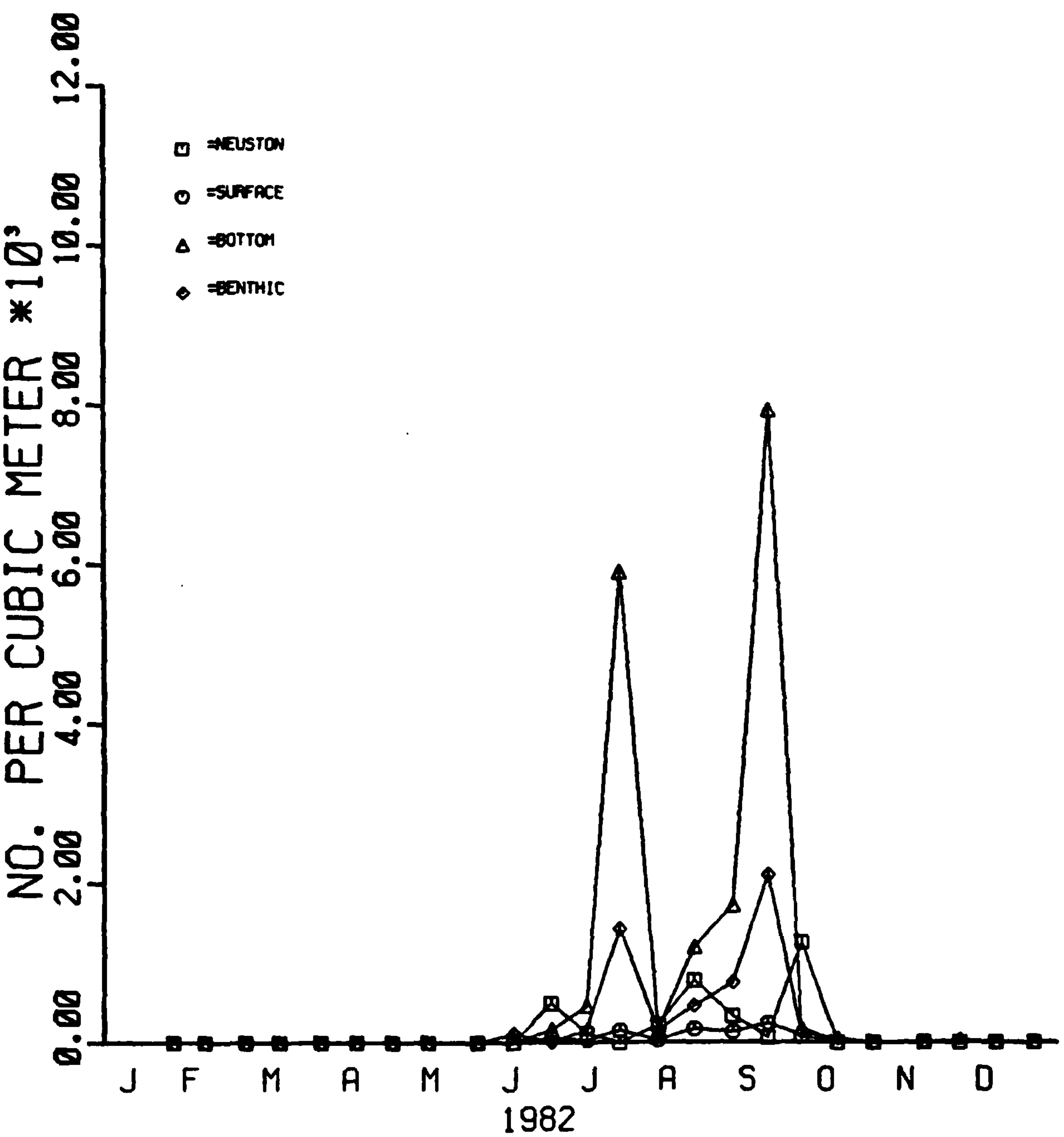

Figure 20. Density of Pinnotheres ostreum zoea by depth by semi-monthly sampling period for 1982 at the South Island of the Chespaeke Bay Bridge-Tunnel.

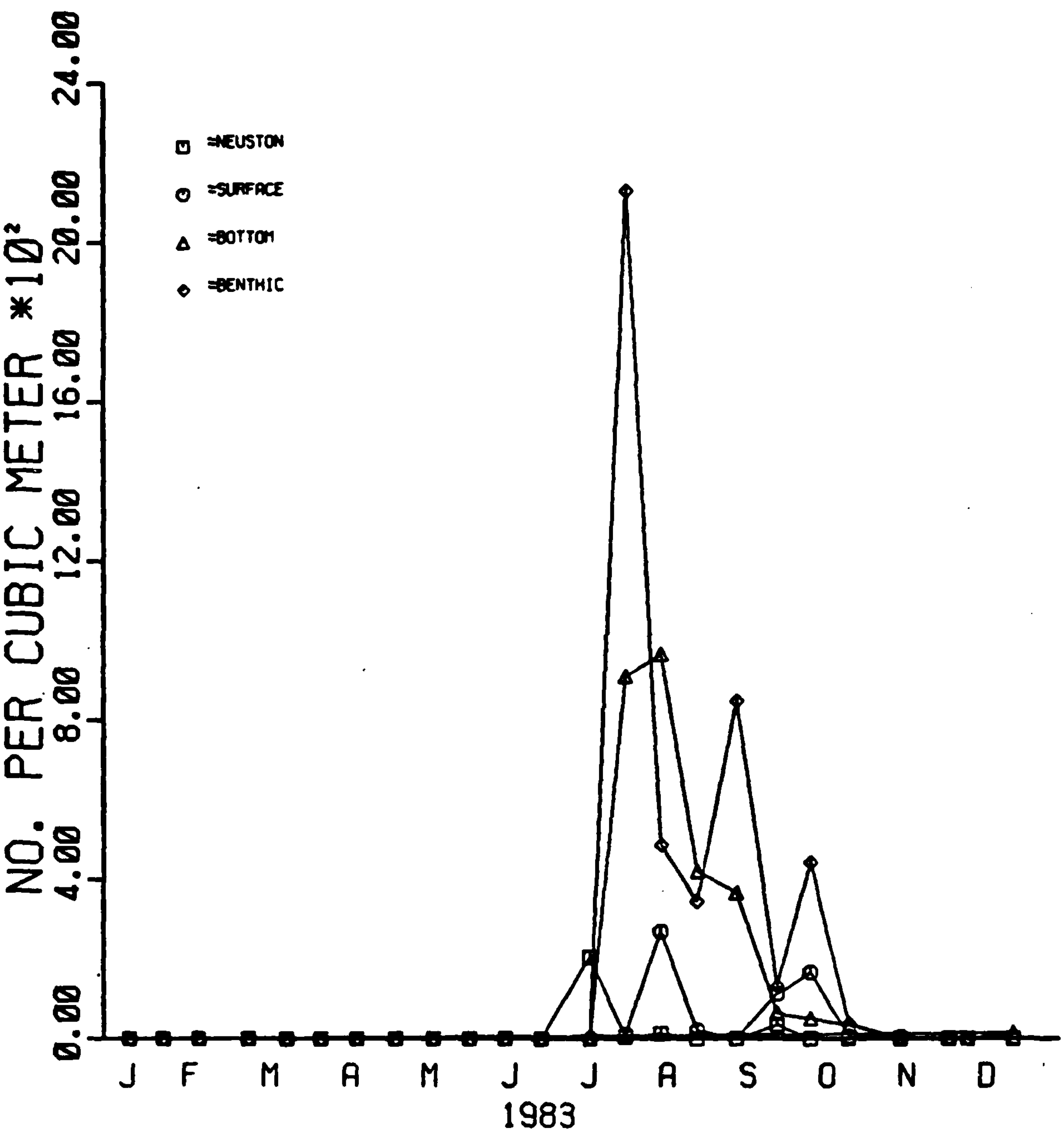

Figure 21. Density of Pinnotheres ostreum zoea by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

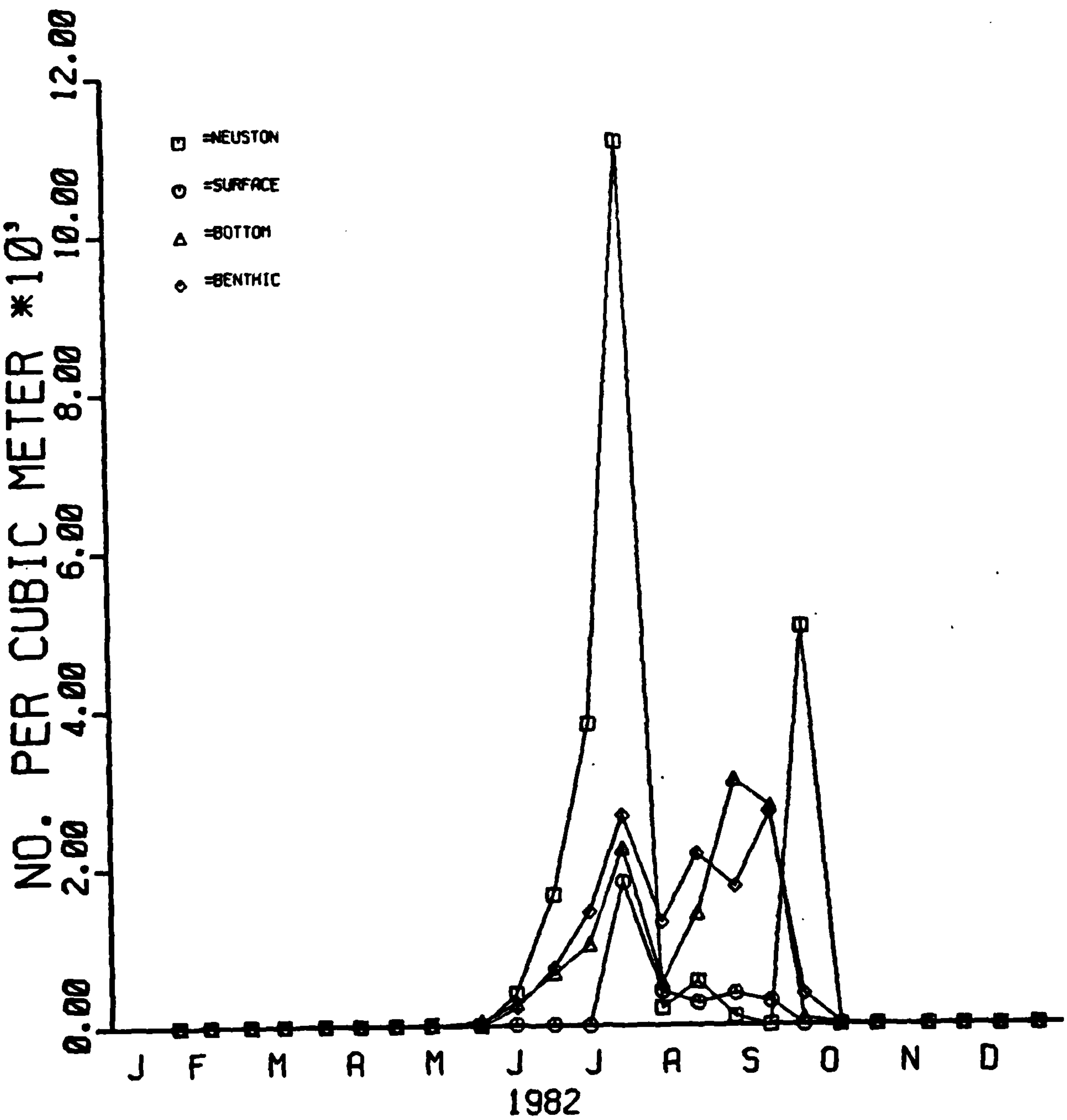

Figure 22. Density of *Neopanope texana sayi* zoea by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

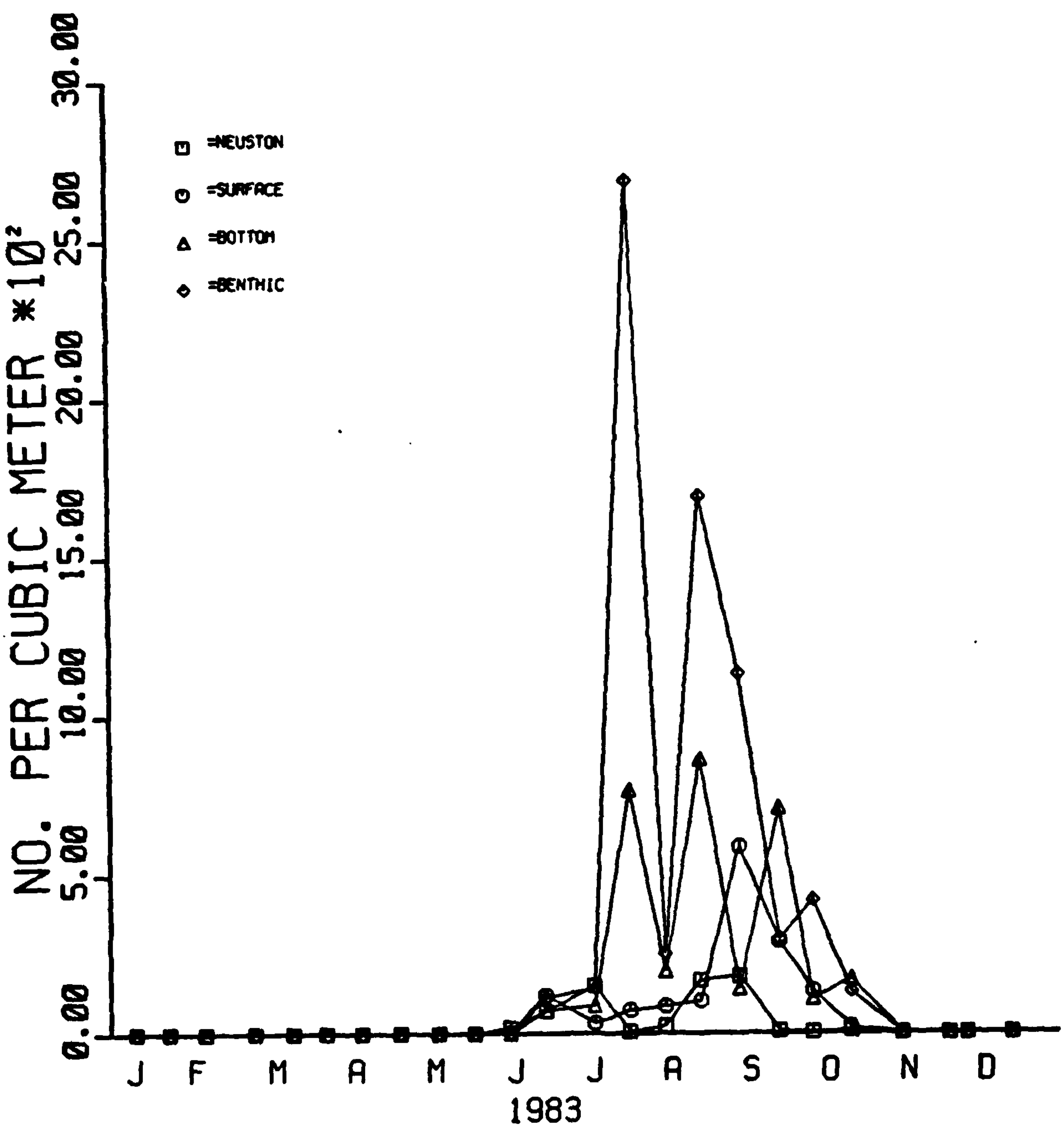

Figure 23. Density of Neopanope texana sayi zoea by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

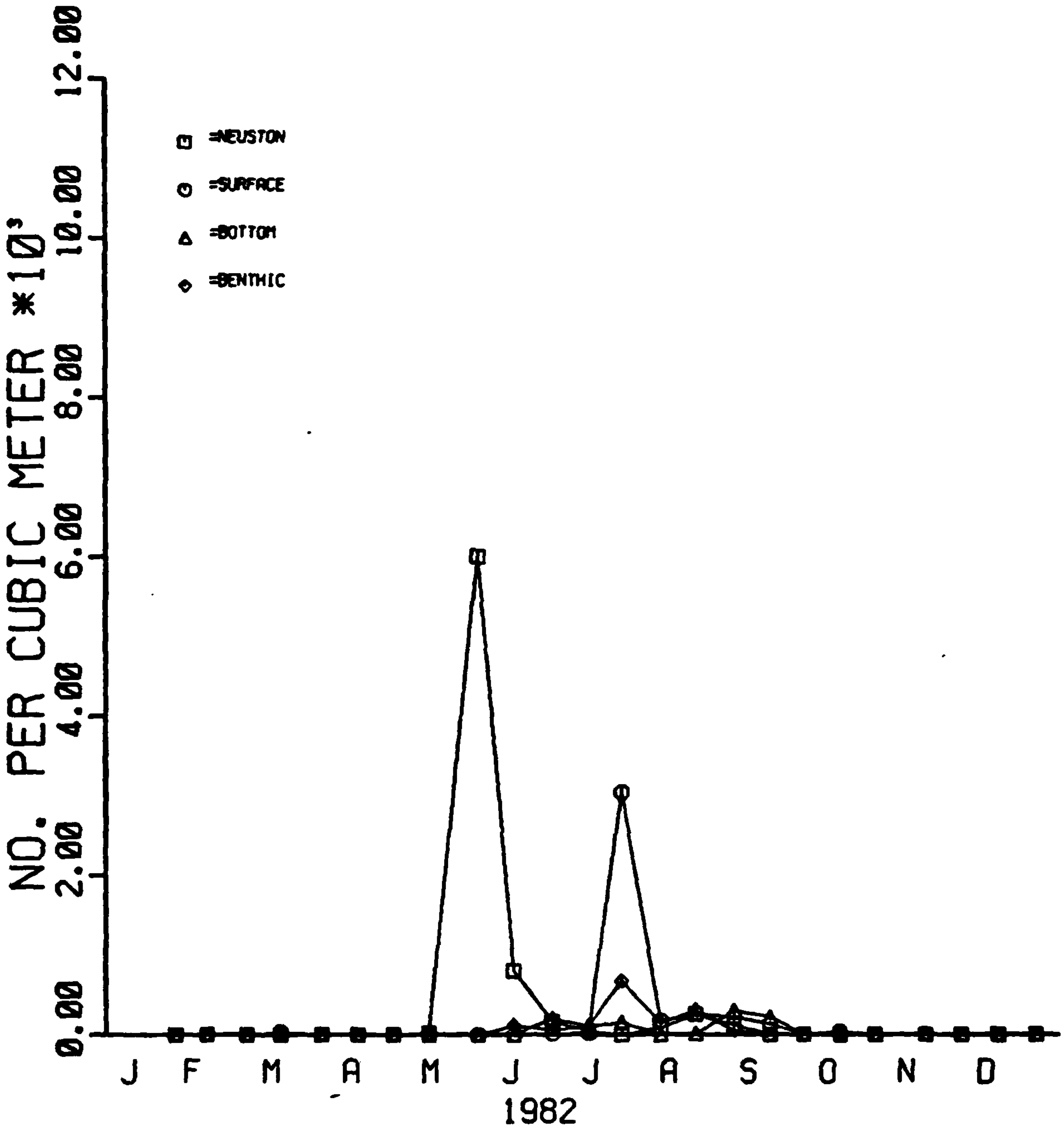

Figure 24. Density of <u>Hexapanopeus</u> <u>angustifrons</u> zoea by depth by semimonthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

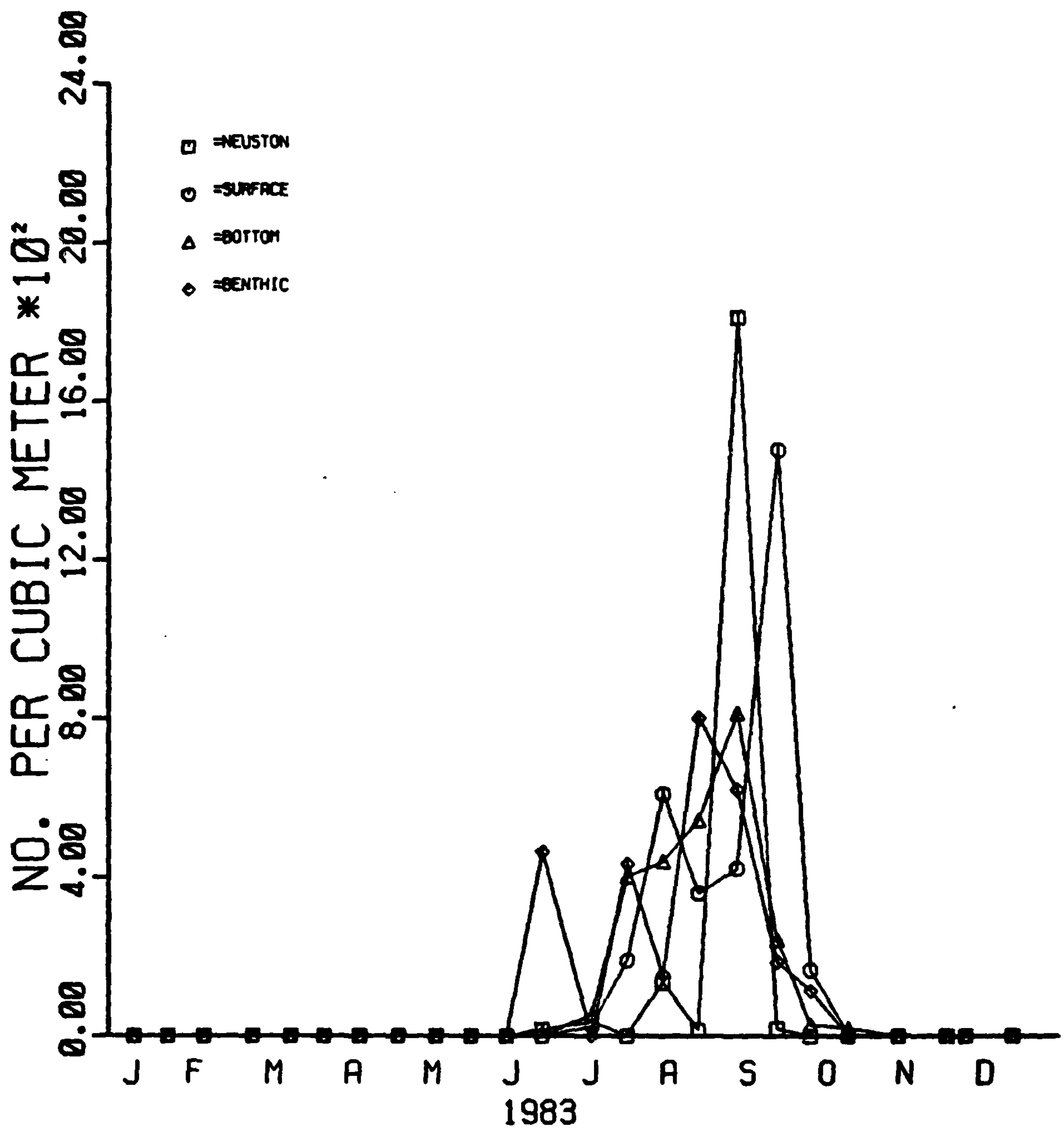

Figure 25. Density of Hexapanopeus angustifrons zoea by depth by semimonthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

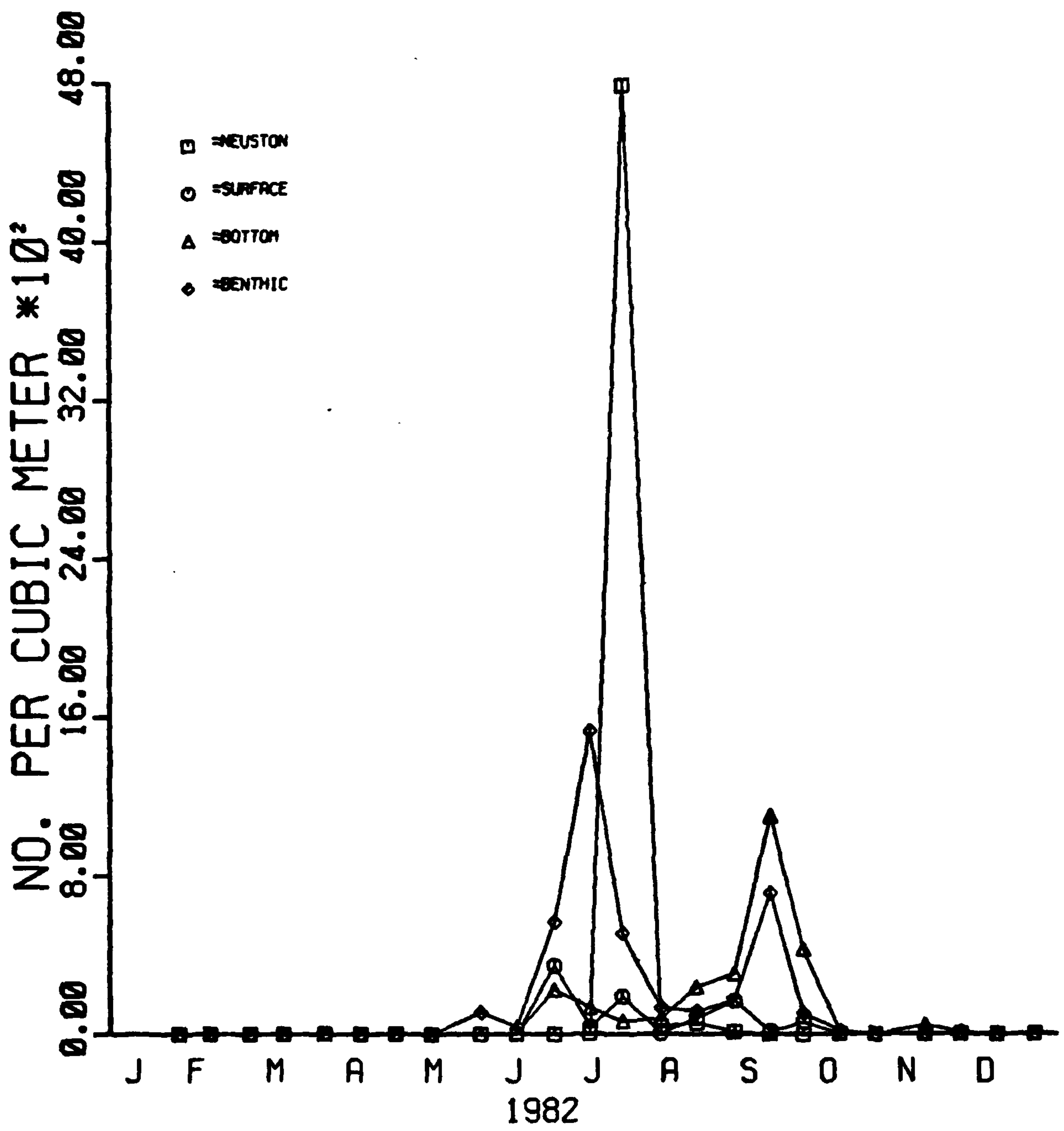

Figure 26. Density of Pinnixa sayana zoea by depth by semimonthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

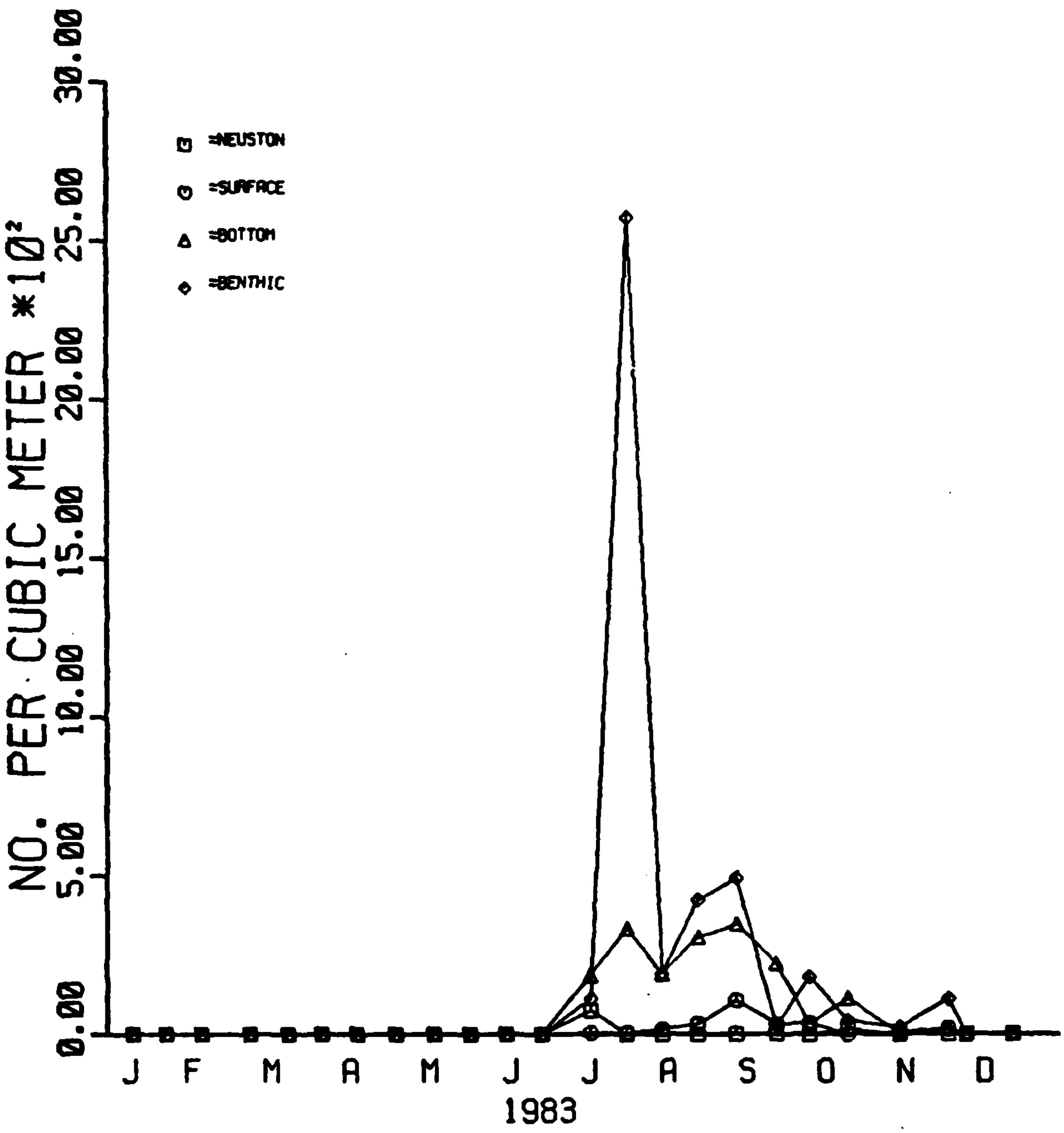

Figure 27. Density of Pinnixa sayana zoea by depth by semimonthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

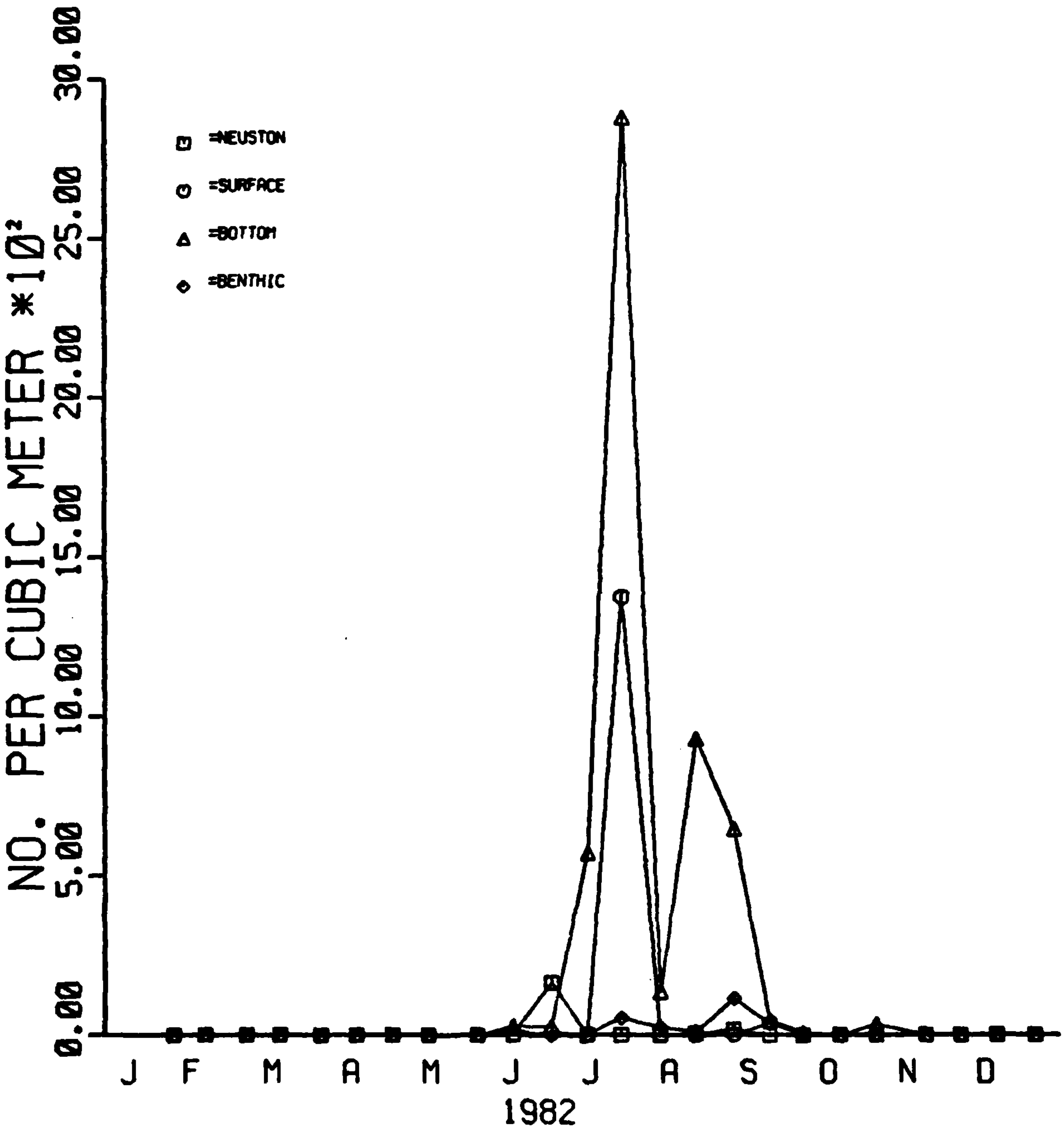

Figure 28. Density of Ovalipes ocellatus zoea by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeke Bay Bridge-Tunnel.

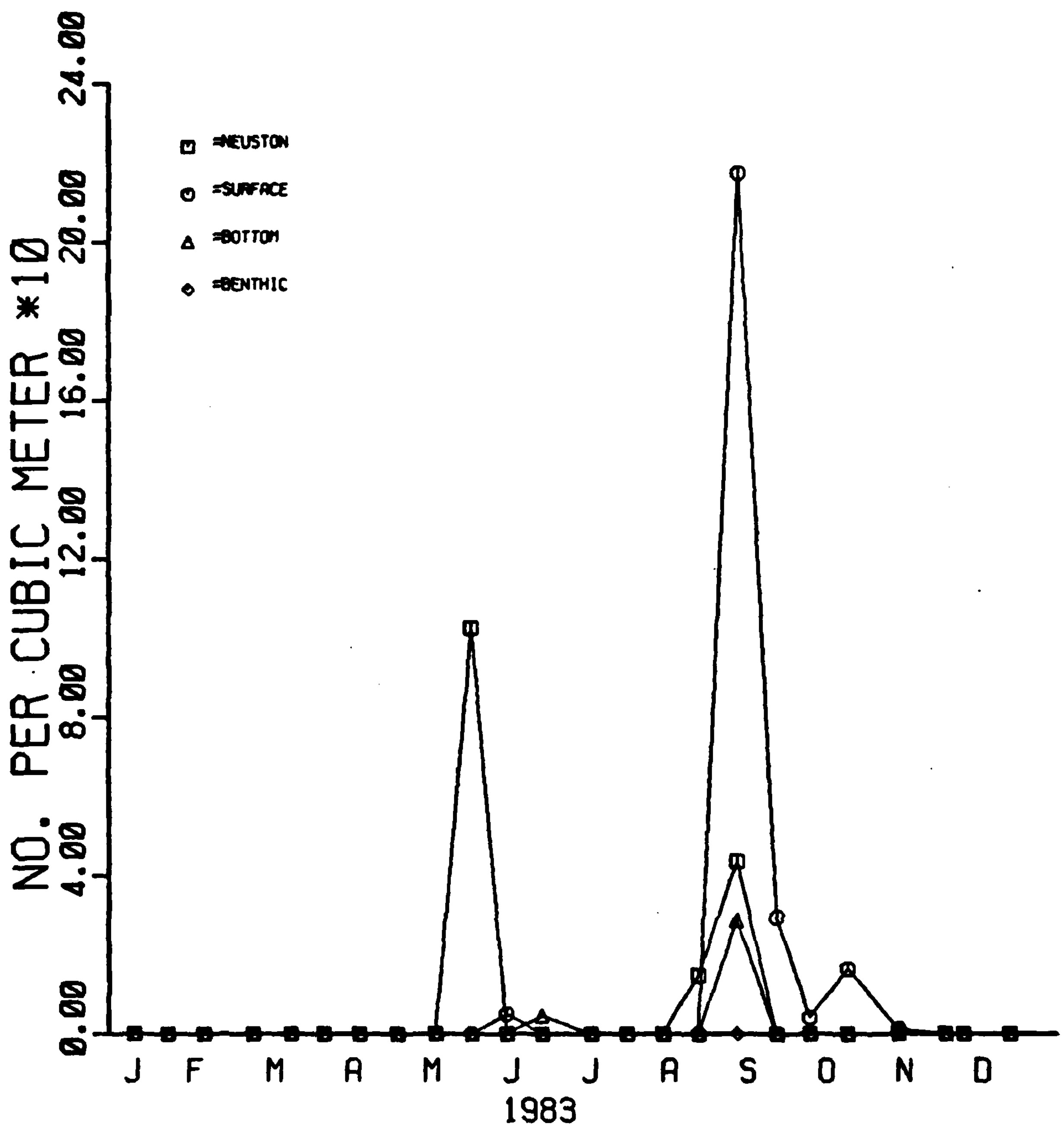

Figure 29. Density of <u>Ovalipes ocellatus</u> zoea by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

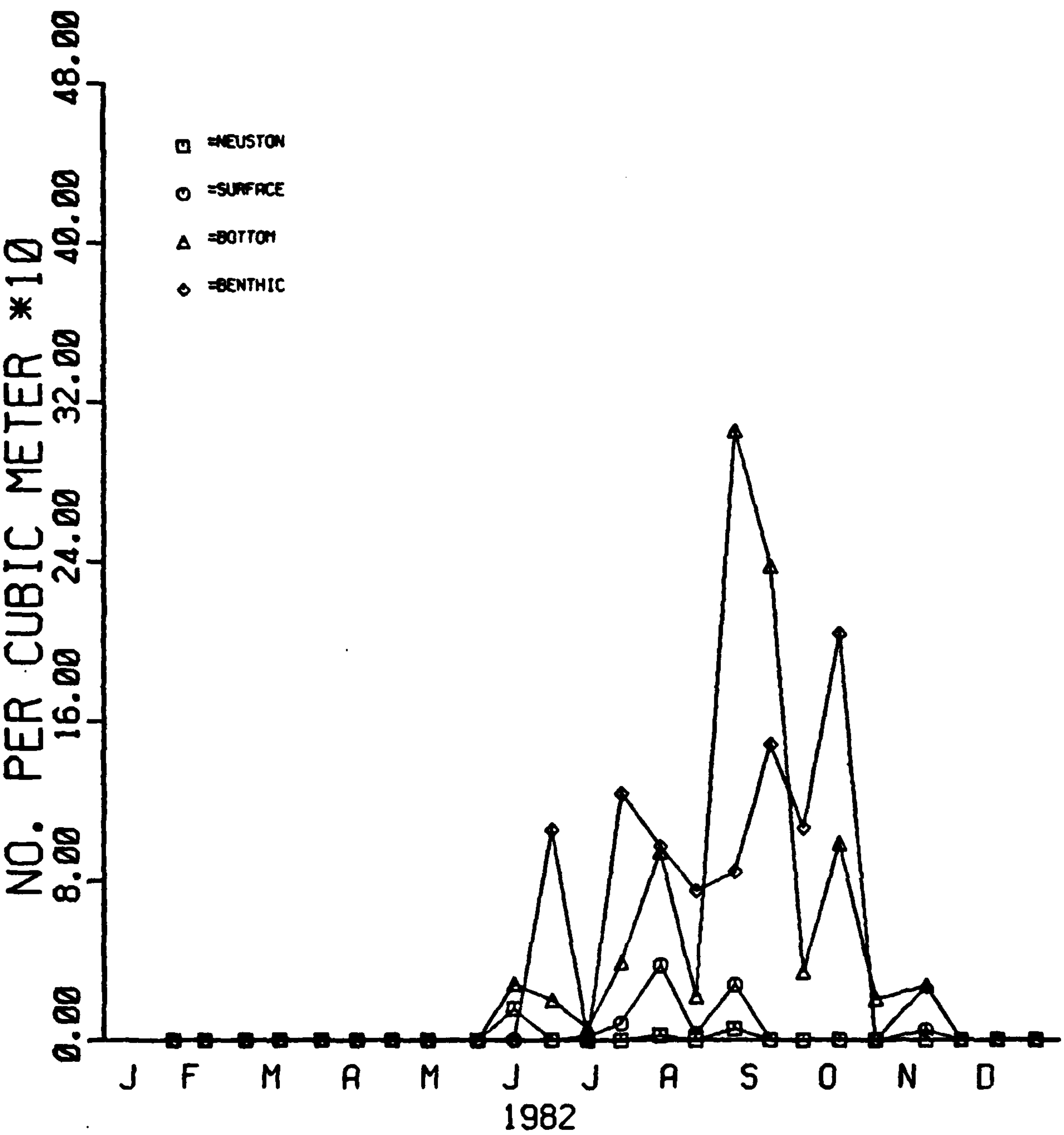

Figure 30. Density of Polyonyx gibbesii zoea by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

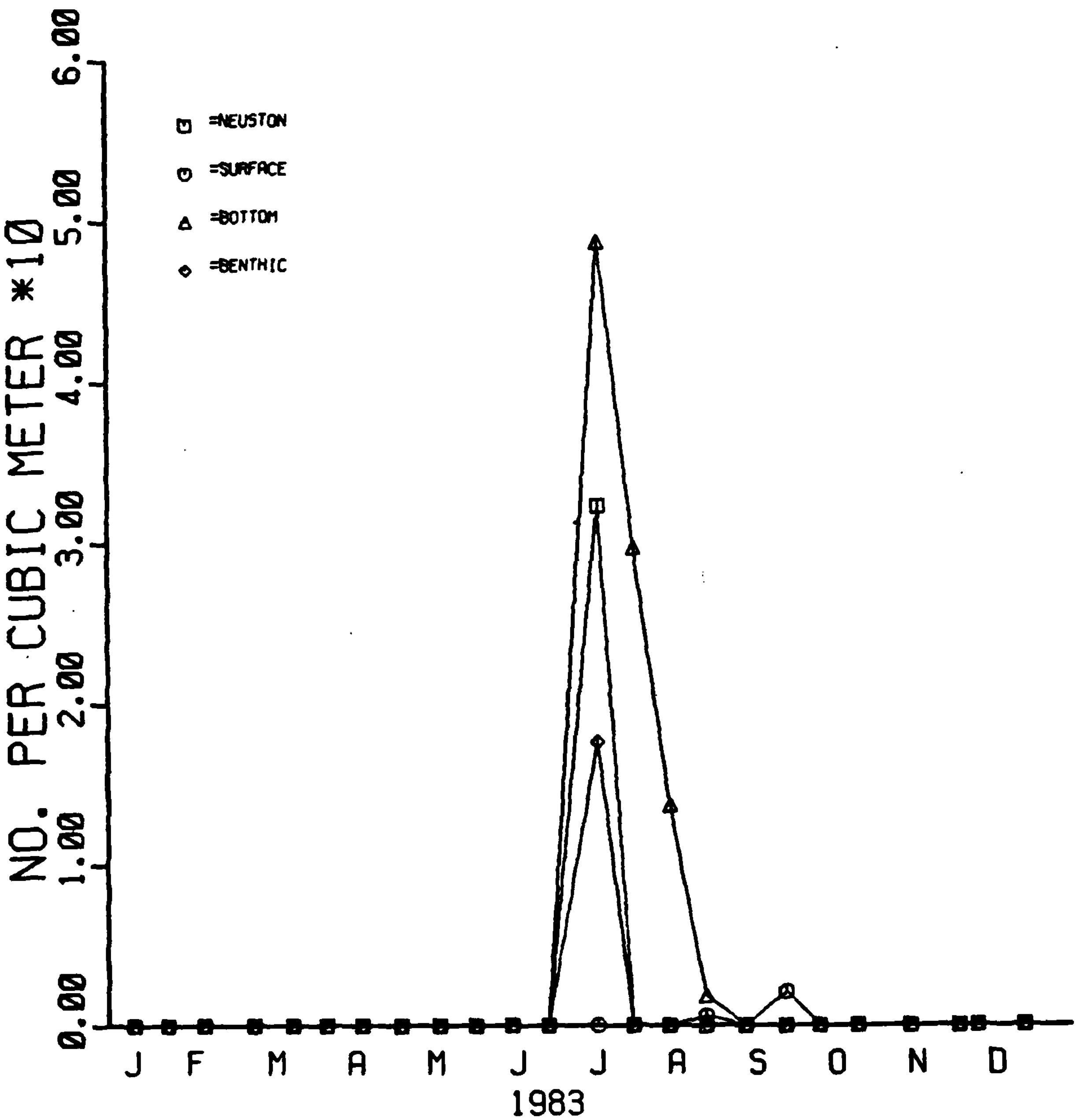

Figure 31. Density of Polyonyx gibbesii zoea by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

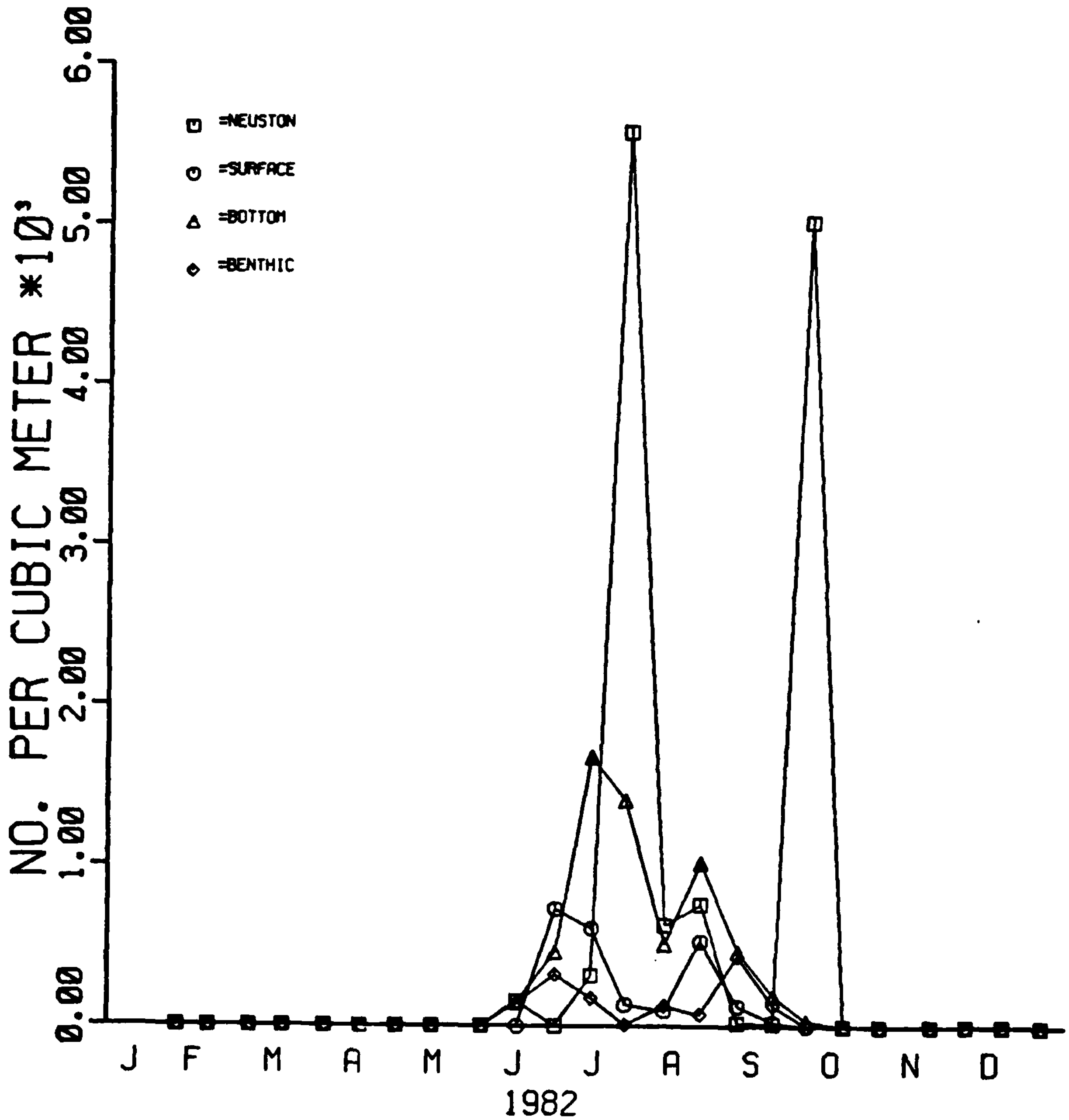

Figure 32. Density of <u>Uca spp.</u> zoea by depth by semimonthly by sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

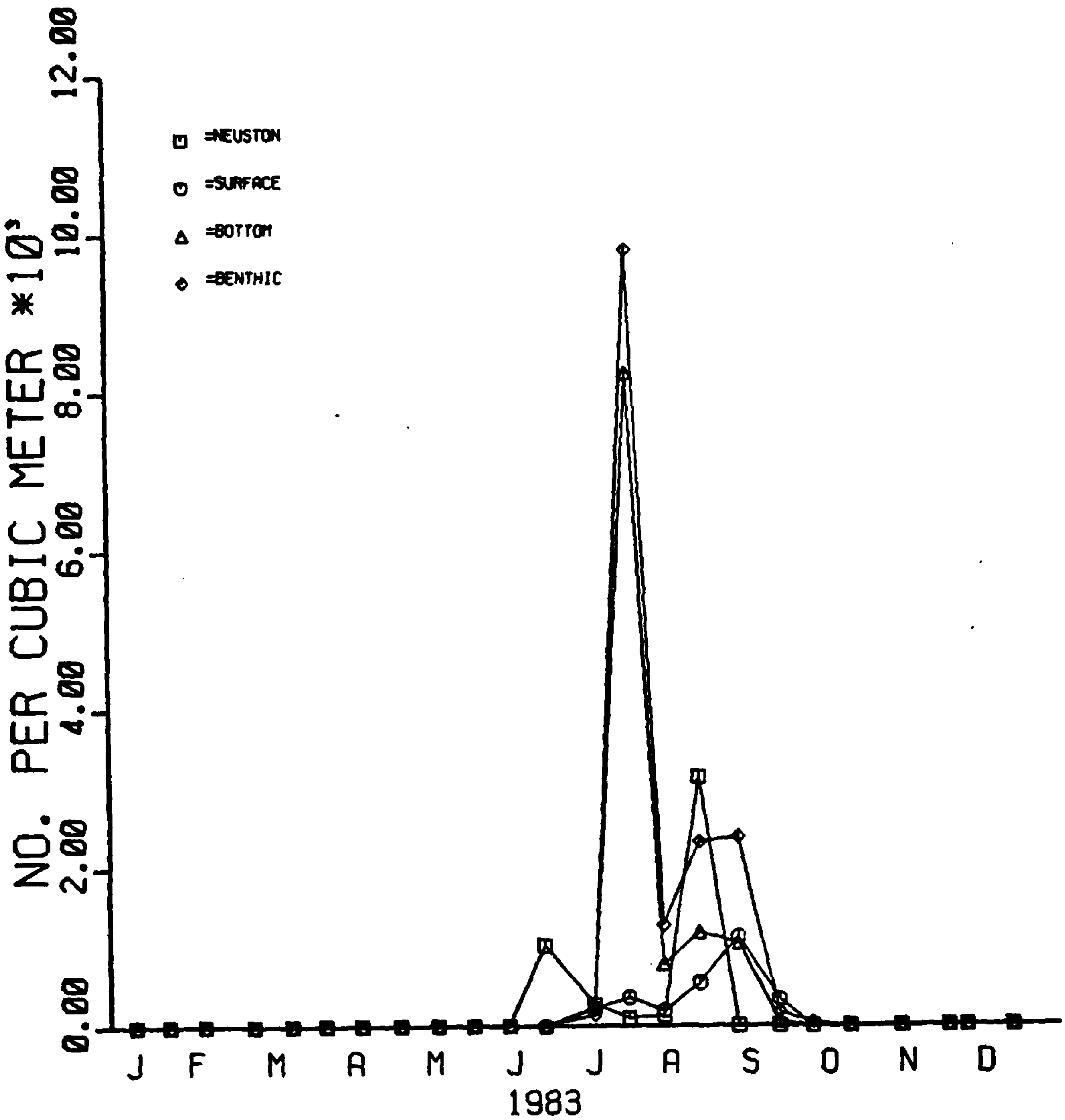

Figure 33. Density of Uca spp. zoea by depth by semimonthly by sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

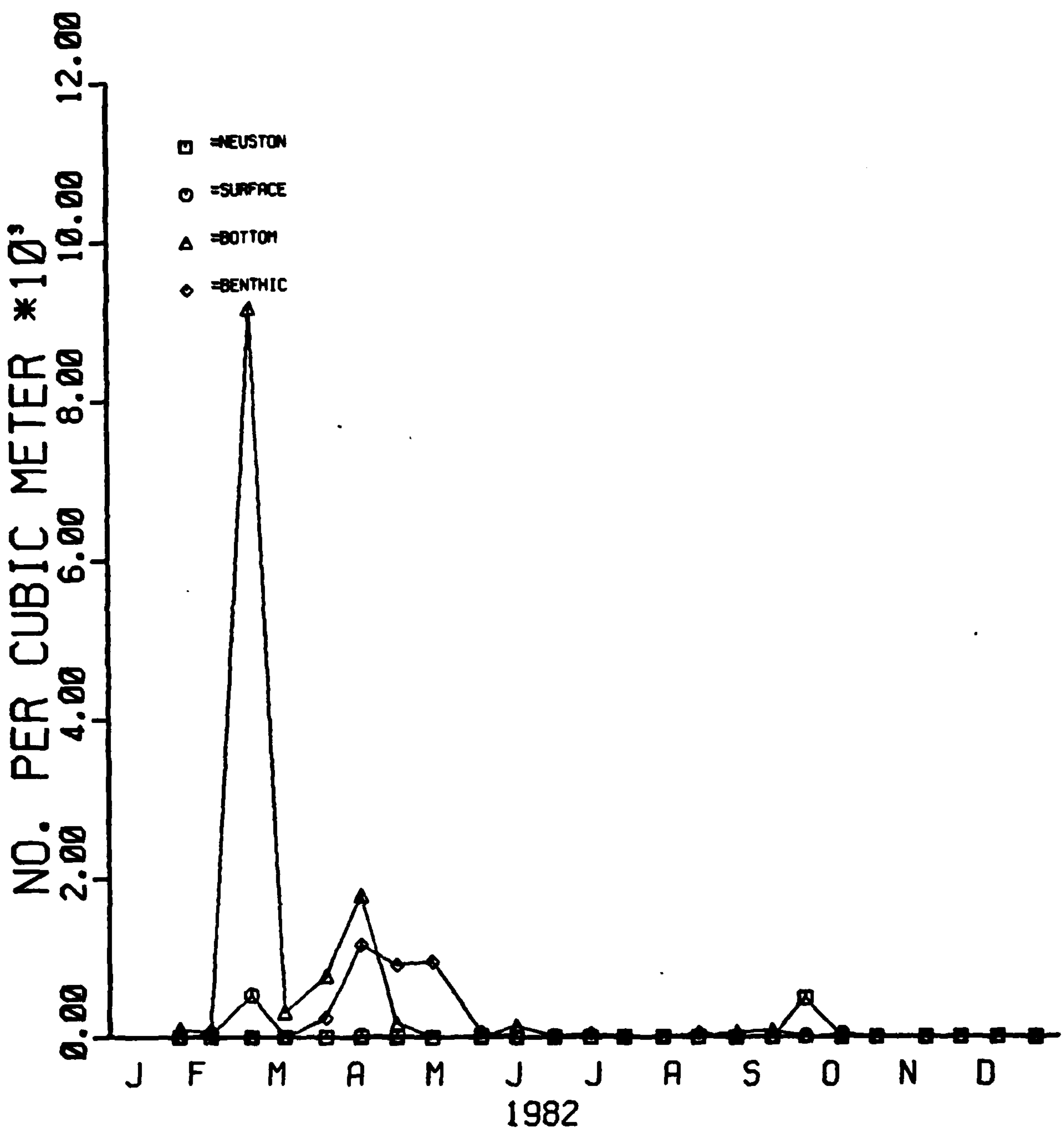

Figure 34. Density of nereid polychaete larvae by depth by semi-monthly sampling period for 1982 at the South Island of the Chesapeake Bay Bridge-Tunnel.

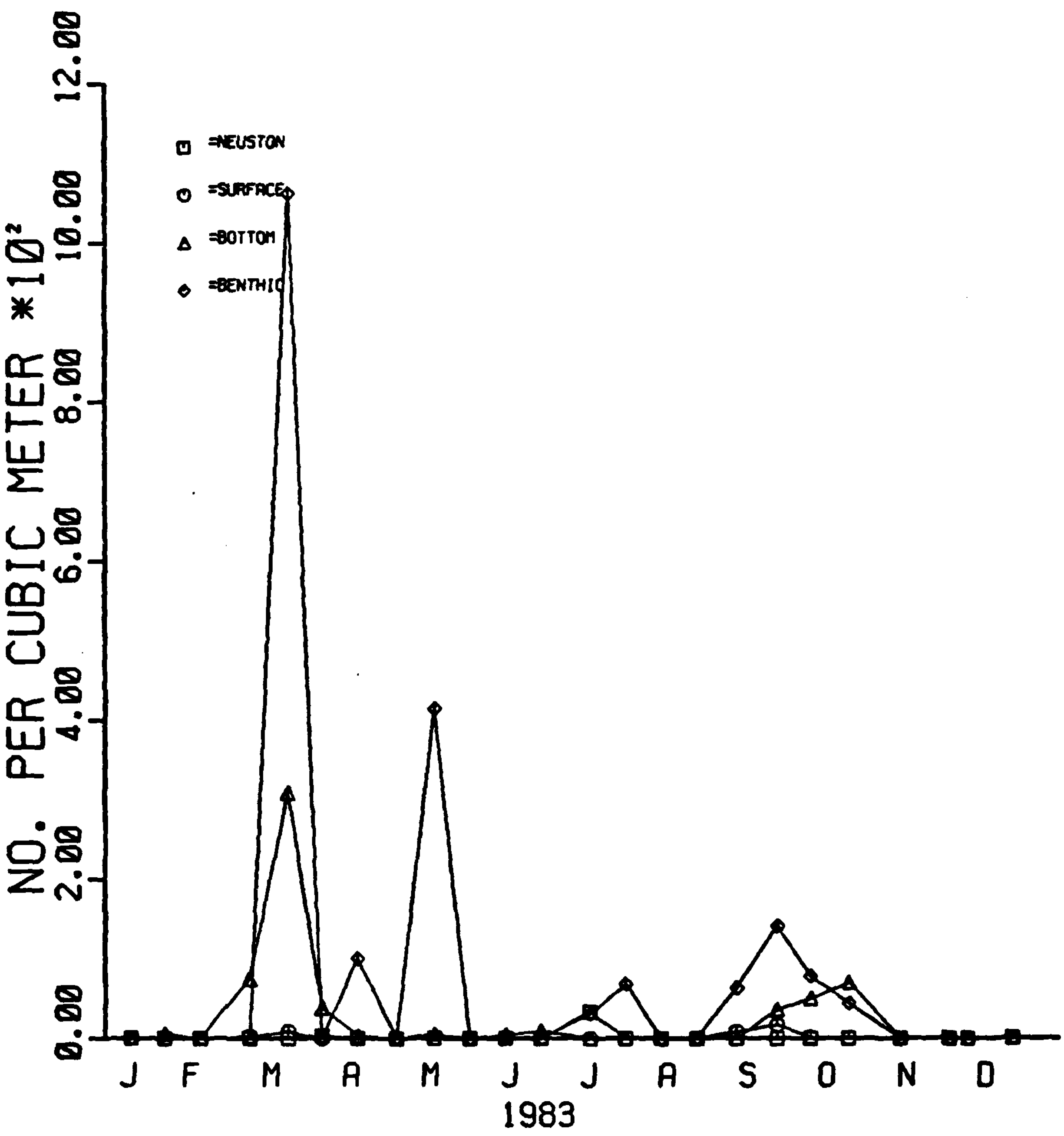

Figure 35. Density of nereid polychaete larvae by depth by semi-monthly sampling period for 1983 at the South Island of the Chesapeake Bay Bridge-Tunnel.

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